Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LIX. OCTOBER, 1920. No. 4.

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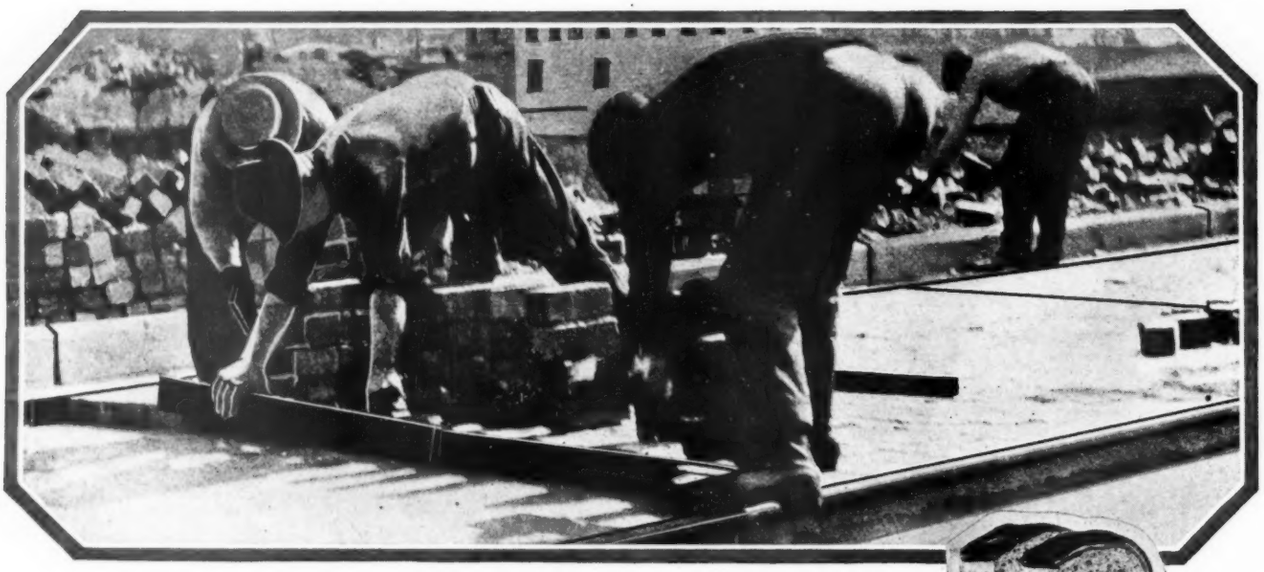

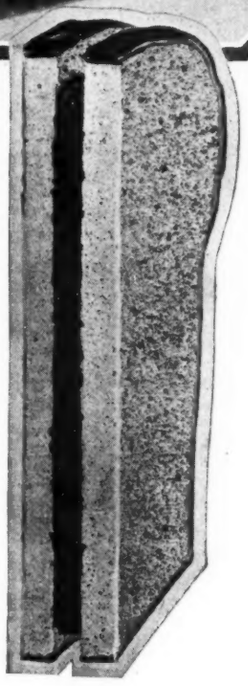

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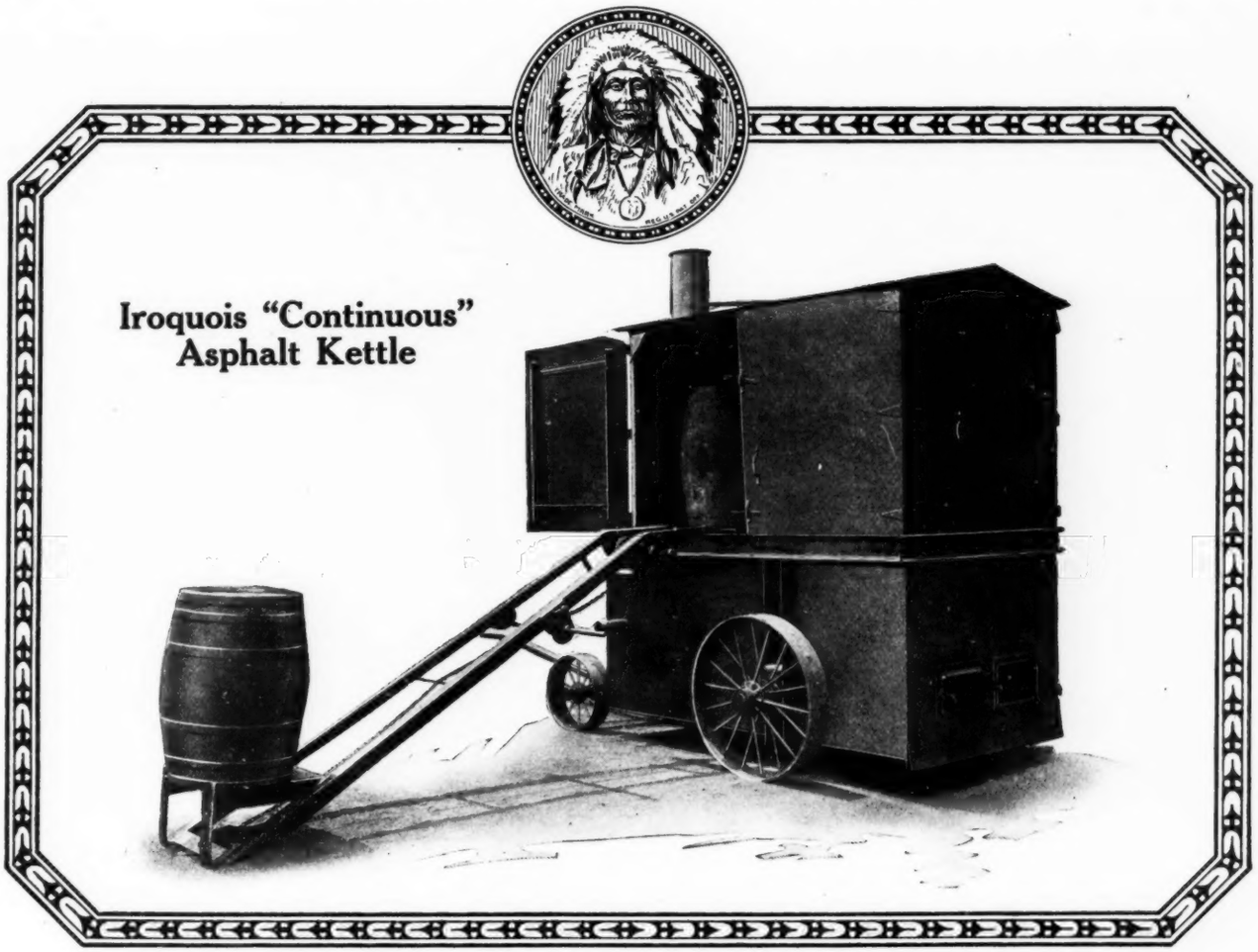

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CONTRACTORS who consider value above first cost—who demand equipment built to withstand long and severe service, use the **Iroquois Line** exclusively. They know "Iroquois equipment makes contracts pay."

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Write at once for Bulletins Nos. 8, 6 and 5.

The Barber Asphalt Paving Company

Iroquois Sales Department

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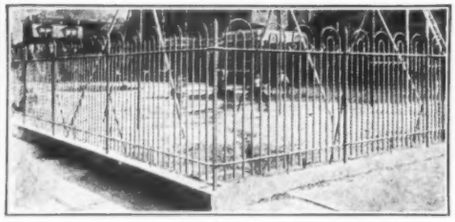

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Beautifies and Protects Buildings

A PUBLIC building without iron fence seems bare and unfinished. An attractive iron fence adds the touch of artistic beauty, and in addition insures adequate protection for untold years to come.

We originate special designs or make fence according to your own specifications.
Full and cordial cooperation with architects, committees and boards, engineers.

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Manufacturers of Ornamental Iron Work, Plain and Ornamental Steel and Iron Fencing, Flower Vases, Settees, Wire and Iron Window Guards, Pipe Railing, Folding Gates, Etc.

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PIONEER Highest Quality ASPHALTS

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Any Melting Point, Any Ductility, Any Penetration

"PIONEER" Mexican Asphalt Cement is a little different and a little better than "most Mexicans;" less susceptible to temperature changes; absolutely uniform; highly ductile, and complies with the strictest specifications.

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Ruberoad Cement

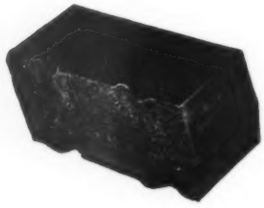
It's New It's Different It's Efficient

Produced from a rubber-like compound. Tough, pliable, adhesive and little effected by heat or cold. Repair your concrete cracks with it,

THE PIONEER ASPHALT CO.

LAWRENCEVILLE, ILL.

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

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**Protection for Concrete Curbs—
Corners of Walls, Columns, etc.**

Truscon Curb Bars provide a substantial protection and reinforcement for concrete curbs, also for exposed corners of walls, pilasters, columns, platforms, sidewalks, etc. Manufactured from open hearth steel, heavily galvanized after forming. Positive anchorage—no separating or splitting of concrete at corners. Owing to their rigidity and convenient size, Truscon Curb Bars are easy to handle and install. Furnished either straight or curved; 1⅝-in. protecting edge.

Truscon Edge Protectors provide a 1-in. protection edge, ample for many conditions, such as corners of platforms, walls, etc.

TRUSCON STEEL CO TRUSCON BUILDING PRODUCTS

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Youngstown, Ohio

Warehouses and Sales Offices in Principal Cities

Reinforcing Steel, Metal Lath, Steel Windows, Steel Buildings, Pressed Steel, Cement Tile, etc.

TEXACO

To Resurface Worn Concrete

Worn concrete pavement before being prepared for resurfacing with Asphalt.

In order to salvage the many miles of worn concrete roads throughout the country, highway officials and engineers are resurfacing their worn concrete roads with TEXACO Asphalt.

Resurfacing worn concrete pavement with Asphalt.

Resurfacing worn concrete roads with TEXACO Asphalt is a step towards economy and time saving, because the worn road may be utilized as a base, thereby saving money and time in construction.

Finished pavement showing Asphalt wearing surface over worn concrete pavement.

In the East and West, North and South, State, County, and Municipal Engineers are salvaging their worn concrete roads with durable, resilient Asphalt wearing surfaces.

How to Resurface a Worn Concrete Pavement with TEXACO ASPHALT

1. The work is very similar to resurfacing worn brick pavements with Asphalt.
2. First, all holes, cracks, and depressions in the worn concrete pavement should be filled with Asphaltic Concrete Binder.
3. If an Asphaltic concrete wearing surface is laid on the worn concrete top, usually no binder is used.
4. If a Sheet Asphalt wearing surface is laid on a worn concrete top, usually a 1½ inch binder is used,

(Specifications Furnished on Request)

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The Texas Company

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Proprietors of MECCA CLAY WORKS

MANUFACTURERS OF

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THAT'S WHAT YOU NEED WHEN TAKING MEASUREMENTS

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PIONEERS IN CONNECTION WITH THE NOTEWORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation. Send for Catalog No. 26.

THE LUFKIN RULE CO. SAGINAW, MICH.
NEW YORK. LONDON, ENG. WINDSOR, ONT.

The ELGIN LINE

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Motor Driven Street Cleaning Machinery

Elgin Sales Corporation

501 Fifth Avenue, New York — U. S. A. — 1340 Old Colony Bldg., Chicago

"BEREA" Sandstone Curbing

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PRODUCED BY

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New Orleans Refining Company
INCORPORATED

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Offices: Maison Blanche Annex, New Orleans, La.

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in the form of increased wood-paving-satisfaction years assured by use of

No Bleeding REILLY'S IMPROVED PERMANENT CREOSOTE OIL *No Bulging*

Republic Creosoting Company, Indianapolis, Ind.
Plants: Indianapolis Minneapolis Mobile Seattle Norfolk

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., October, 1920.

MOTOR TRUCK OPERATION AND ACCOUNTING LXII

Use of Motor Trucks on Highway Maintenance Work in Wisconsin

The following is from Bulletin No. 11 on Highway Maintenance, recently issued by the Wisconsin Highway Commission, and especially devoted to Partial Maintenance on the State Trunk Highway System:

Each county should own one or more 2 to 3-ton motor trucks for use in delivering material to the patrolmen where the maintenance material must be hauled a distance of one mile or more.

With the scarcity of labor and the high price of horse feed several counties have installed motor truck patrol on earth road sections and find that it is fully as cheap and gives better satisfaction on heavy traveled roads than does the team patrol. On heavy traveled earth road sections it is very important that the surface is smoothed up with a grader or planer within a few hours after the surface is dry enough to operate on. With a motor truck pulling two Wisconsin Road Planers it is possible to get over a 20-mile section in a half a day, which is a very important consideration, as the traveling public wishes the earth road surfaces smoothed up as soon as possible after each heavy rain.

During dry weather the patrolman can haul gravel or other material for surfacing the worst places, and when required a team can be employed to do work that the truck can not perform.

There are but few counties using motor trucks for either construction or maintenance work that knows the true unit cost of operating the trucks, which cost must allow for depreciation and upkeep, as well as for cost of operation.

Form No. 149, herewith, has been devised for the express purpose of keeping the true cost of motor truck operations. Each construction job or patrol section is charged with the work performed by each truck, the truck being credited with the same. The fixed and operating costs of each truck are charged to the individual truck. This method places each truck on a business basis. The same method is employed in keeping tractor costs.

FORM FOR KEEPING MOTOR TRUCK COSTS ON WISCONSIN HIGHWAY MAINTENANCE WORK

.....

Form 149

TRUCK DRIVER'S TRIP REPORT

County of .....Truck No.....

Charge to { Construction Job / Patrol Section } No..... Date.....19....

Trip No.....Odometer reading Out..... In.....

Miles run.....Hours run.....Hours lost.....

Materials Hauled

Stone .....Cu. Yds. Lumber.....B. M.
Gravel .....Cu. Yds. Oil or Tar.....Gallons
Sand .....Cu. Yds. Steel .....Pounds
Cement .....Bbls. .....
Pulling Grader—Planer .....

DAILY EXPENDITURES

Gasoline	.....Gallons—Cost	$.....
Lubricating Oil	.....Gallons—Cost	$.....
Grease	.....Pounds—Cost	$.....
.....	..... Cost	$.....
.....	..... Cost	$.....
	Total.....	$.....

Weather.....

.....

Driver

Performance of Trucks on a Minnesota Excavating Job

In excavating for the foundations of the new Northwest Branch of Montgomery Ward & Co., motor trucks were used exclusively by the excavating contractors, J. L. Shilly & Co. of St. Paul, Minn. The excavation necessary for this immense plant now under construction at Midway, between Minneapolis and St. Paul, measures 850 ft. by 350 ft. with an average depth of 22 ft., or a total of about 240,000 cu. yds. of material to be moved.

An average of 9 trucks per day were used per shift, reports Geo. D. Steele in the Diamond T Accelerator. One of these trucks was a standard 5-ton Model S Diamond T, working with 7 trucks of 50% greater rated capacity and one other standard 5-ton truck. Overloading was excessive on the 5-ton trucks, as it was necessary for both of the 5-tonners to carry the same number of cubic yards of material and to make the same number of trips as the 7½-tonners.

The material hauled was clay and sand, the top 6 feet of the excavated material being clay and the balance a heavy damp sand. The clay weighed 3,200 lbs. per cu. yd., and the sand 3,100 lbs. per cu. yd. All loading was done with an Erie Revolving Steam Shovel with a ⅝ yd. bucket. In computing weights in the figures which follow, 3,100 lbs. have been used per cubic yard.

All trucks were equipped with standard 5-yd. steel dump bodies operated by vertical hydraulic hoists. So severe was the work that hoist arms were broken and bent continually on all trucks. The haul from the excavation to the dump was over smooth, level wood-block paving, the round trip being 1.65 miles. The dump was a bad one, and on a dozen or more occasions, the trucks went over when the soft material gave way.

One of the Diamond T District Managers worked on the Model S, on several different occasions, watching the performance of all the trucks, and keeping accurate costs on the Model S. Its performance during one afternoon was as follows:

On all trips nine heaped shovel buckets of material, equivalent to ¾ cu. yd. per bucket, were loaded on the truck, making a total of 6½ cu. yds. per trip on six trips and 7¼ cu. yds. per trip on the other 8 trips, or a total of 14 round trips in the afternoon.

The distribution of time was as follows:

Average waiting time to load	6 mins.
Average round trip shovel to dump	12 mins.
Average time to actually load	3 mins.
Average round trip per hour	3
Total round trip	14
Total mileage covered, including garage to work and back to garage with trip in morning to body and hoist manufacturer to repair broken arm on body	38.3 miles
Total cubic yards hauled	97
Total tonnage carried	150.35
Average tonnage carried per trip	10.74

DUPLEX TRUCKS

BUILT FOR BUSINESS

IN a run from Los Angeles to El Centro via San Diego with a 3060 pound load, it made 267 miles in 8 hours 26 minutes—an average speed of 34 miles per hour. It went the full distance without a stop and the speed limit was observed in all towns in transit.

Another Limited running from New Orleans to Baton Rouge, 124.6 miles, carrying 3750 pounds, made the distance in 6 hours, 55 minutes running time.

The Only Motor Truck With All These New Features In It

Read These Features—Think What They Mean—And You Will Agree That Here Is a Truck That Must Be a Wonderfully Good Investment

YOU know what's the need of the hour in trucks. If you have been a truck user for any length of time you have probably had some experiences that have given you an entirely new angle on motor trucks and their value.

You don't need to be told of the shortcomings of the old truck standards, but you probably are tremendously interested in learning about the real features of a truck that you can depend on.

It is on this basis of honest value to you and to every other user that the Duplex Limited is made and sold.

Do you know that the Duplex Limited is probably the fastest and most rugged truck of its size and capacity in America.

Do not make the mistake of thinking that this truck is merely a speed truck. It isn't—its a strong, rugged truck built to carry 3000 to 5000 pounds and it gets its speed from motor power—not gear ratio.

Built and designed for pneumatic tires—standard tread—it takes roads as they come and averages express train speed. It has probably the most perfect balance ever developed in a truck. Friction is saved everywhere possible by using ball bearings throughout. Scientific tests show that it takes 29 times less power to move a given load when ball bearings are used as against any other type. This wonderful balance and almost frictionless running makes a big saving in gasoline.

You get further saving in gasoline because the truck has complete electric equipment, including starter. That means that the driver *will* shut off the motor when the truck is idle and he will save you from 2 to 4 gallons a day that way alone.

The patented Duplex Spring Suspension for the radiator allows ¼-inch sideways and 1-inch up and down movement before the radiator touches anything solid.

This eliminates at one stroke the greatest single source of radiator leakage and consequent motor damage from overheating.

Put your hand in the crank case of a Duplex Limited that has run over dusty roads and notice that there is no sand or sediment in the oil. This is due to the fact that there is a special flapper valve arrangement that keeps the sand and dust out of the lubricating system.

See the Duplex dealer near you—he will give you any demonstration you want and let the truck speak for itself. He is a responsible man—he will not exaggerate and he stands ready to back up, as we do, every truck that bears the name "Duplex." Get the facts about the Duplex Limited.

Write us direct for details about the two wonderful runs of the Limited and also for free copy of "DUPLEX DOINGS," the Truck Users' Magazine.

For heavy duty, the Duplex 4-Wheel Drive is everywhere admitted to be in a class by itself. Power in every wheel, 3½ tons capacity—it keeps going as long as the wheels touch ground and for heavy work is without question the most economical truck in America.

DUPLEX FOR BUSINESS

Duplex Truck Company

Lansing · Michigan

One of the Oldest and Most Successful Truck Companies in America

Gallone of gas actually used..... 13.5
Cost of gasoline per gallon..... .282
Quarts of oil used.....2
Cost of oil per quart.....20c
Salary of truck driver per week of six 8-hour days $40

Basis of payment was $2 per load, regardless of yardage or tonnage hauled. This gives an average of 2.837 miles per gallon of gasoline with over a 100% overload, which is a remarkable showing.

This same Model S, together with five other St. Paul-owned Diamond T dump trucks, is now working on a large road contract near Baltic and Pipestone, South Dakota, where they are receiving from $85 to $100 per day on hauls ranging from 6 to 9 miles.

New Wrecker Outfit

The Standard Garage of Toledo, Ohio, are pioneers in what bids fair to be an important factor in the automobile industry.

The progressive "automobile hospital" has purchased a truck equipped by the Mansfield Steel Corporation with a Mead-Morrison Motor Truck Winch and apparatus for handling wrecked or disabled automobiles.

This outfit is called an "automobile ambulance" and it is living up to its name in every respect. Without being cumbersome in size—the truck is a 1½ ton Paige—this ambulance is able, with the aid of the Mead-Morrison Winch and one man, to lift, easily, automobiles weighing nearly 10,000 lbs. This is done by a simple hoisting apparatus for which the winch furnishes the motive power. Ordinarily this operation would require the services of several men and would consume much time.

Another important feature of the automobile ambulance is its ability to pick up a car from the rear without damaging fenders, tank or body. This has always been a problem for the garage man when a rear wheel or axle is broken or damaged.

As an all-around aid to the handling of "injured" cars the auto ambulance has proved itself a practical success.

Drawing Road Graders and Drags With Trucks

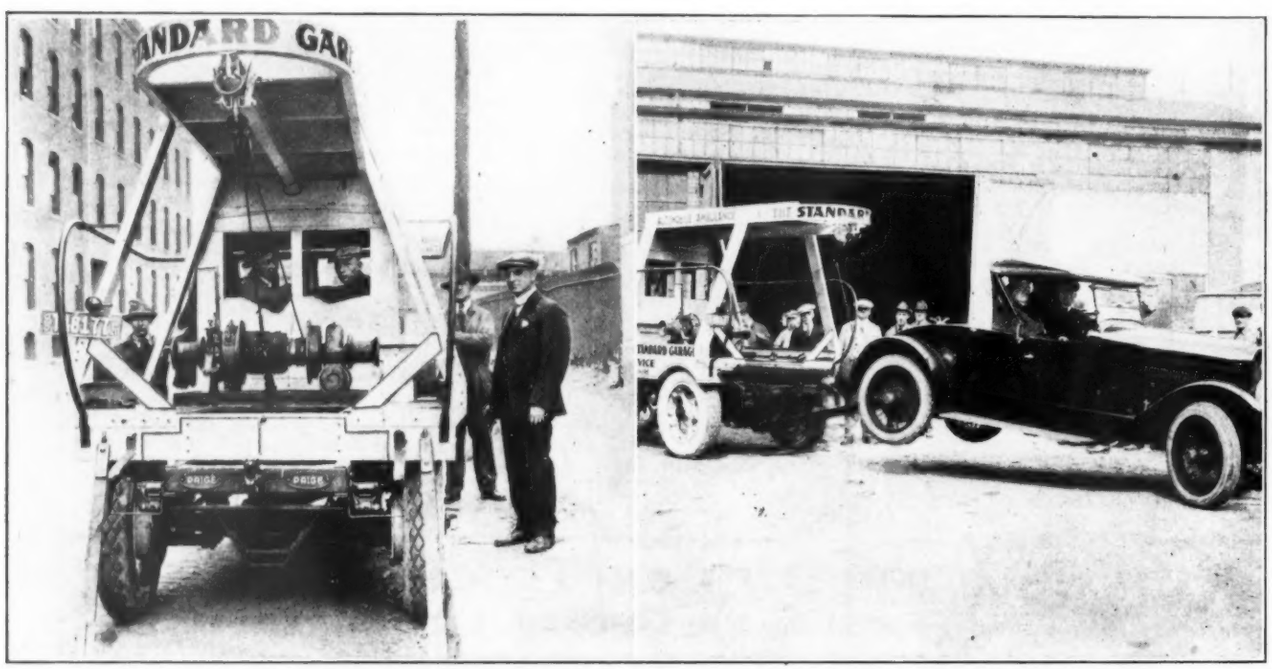
"In road building the advantages of the motor truck over horses for handling of graders and drag work are many," says Harry Branstetter, Chicago Kissel distributor.

"We are hearing many instances every week of Kissel truck owners in the contracting business employing them in road construction work in the place of horses. For instance, a Heavy Duty model will pull the average 6 or 8-horse drag or grader at a rate twice as fast as horses will pull it, and keep going all day long, while horses on the same work would have to stop for a breathing spell every little while.

"This size truck referred to, handles a grader or drag that generally requires six or eight horses. Because it goes twice as fast, it in reality does the work of 12 or 16 horses and even more, on account of not losing time for breathing spells.

"Again, the old fashioned way to grade a road was to haul a load of gravel weighing nearly a ton and a half, employing a team and dump wagon. The gravel was dumped in a pile and then raked apart with a shovel or grader to what appeared to be an even surface, but the fact is that the first of the load went down with the weight of the balance of the load to pack it, while that spread with the shovel or grader was loose—therefore as the traffic packed the gravel it was inclined to be wavy.

"Today this same work can be handled with the Kissel Heavy Duty truck eliminating uneven spreading of the load, by employing the right kind of a road builder body equipped with a tail gate, the body being so arranged that it will open any desired width, thereby allowing the gravel to be put on the road from 2 to 6 ins. in depth as desired. The gravel is dumped and spread as the truck drives along, requiring no spreading and falls with an



PAIGE 1½-TON TRUCK EQUIPPED WITH MEAD-MORRISON WINCH FORMS HIGHLY EFFICIENT "AUTOMOBILE AMBULANCE."

MEAD-MORRISON SERVICE

LIFTS THE LOAD OF INDUSTRY

EACH piece of material-handling equipment turned out by Mead-Morrison Engineers has proven itself not only remarkable for the ease with which it performs difficult work and saves time and money, but also for the gratifying way in which it maintains a steady average of accomplishment.

MEAD-MORRISON
Under-Slung Truck Winch

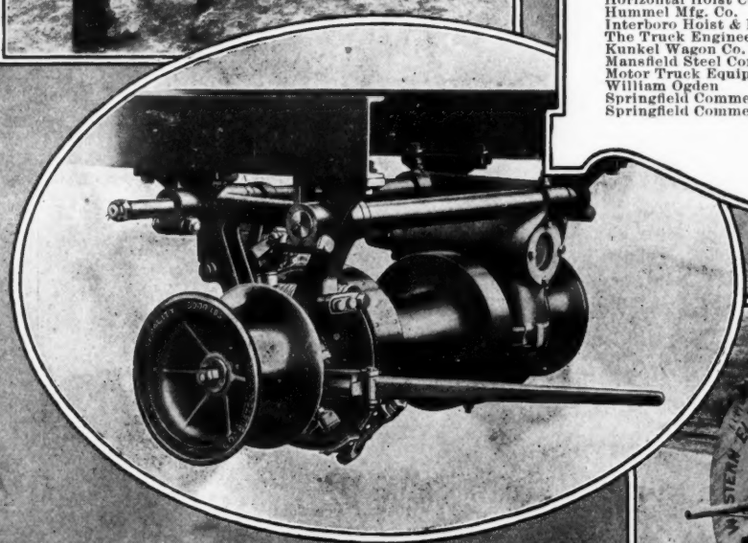
The Under-Slung Winch—the latest Mead-Morrison product—is typical of Mead-Morrison ingenuity and efficiency.

It fills a long-felt want among telephone companies, street railways and logging camps. Instead of being placed on the floor of the truck it is attached to the rear where it is easily accessible for work of the sort done by the above named industries.

Write for Literature

DISTRIBUTORS

Auto Truck Equipment Co.	Pittsburgh, Pa.
Edward R. Bacon	San Francisco, Cal.
Horizontal Hoist Co.	Chicago, Ill.
Hummel Mfg. Co.	St. Louis, Mo.
Interboro Hoist & Body Co.	Brooklyn, N. Y.
The Truck Engineering Co.	Cleveland, Ohio
Kunkel Wagon Co.	Baltimore, Md.
Mansfield Steel Corpn	Detroit, Mich.
Motor Truck Equipment Co.	Philadelphia, Pa.
William Ogden	Indianapolis, Ind.
Springfield Commercial Body Co.	Springfield, Mass.
Springfield Commercial Body Co.	Cambridge, Mass.



Engineers and Contractors

MEAD-MORRISON
MANUFACTURING COMPANY

1026 Prescott Street EAST BOSTON, MASS.

Coal Handling and Hoisting Machinery

Pulling Power of PIERCE-ARROW 2-ton, 3½-ton, 5-ton Dual Valve Trucks

The Dual Valve principle produces greatly increased power, a surprising operating economy and a surpassing performance.

INCREASED valve area facilitates the intake and exhaust of gas while the double ignition assures complete combustion—delivering *the full power* of the explosion and *saving gasoline.* It effects important saving in operation and maintenance and increased efficiency.

OTHER advantages produced include accessibility to quick repairs and easy operation—both vital to time-saving and reduction of labor costs.

This has been accomplished without sacrifice of durability, long life or continuous operation—pre-dominant Pierce-Arrow characteristics.

Pierce Arrow

48 of the FIRST FIFTY trucks still running after 9 years' service.

Delivers more work in a given time.

Loses less time on the job and off the job.

Costs less to operate and less to maintain.

Lasts longer, depreciates less, commands a higher resale price.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

even pressure. Therefore, the roads will be smooth after the traffic has packed it.

"This improvement over the old way is but another example of the great economic value of the motor truck, that not only helps greatly in the construction and maintenance of roads and streets, but when operated in highway transportation, makes the money invested in the construction of highways pay a large and immediate money return."

Gravel Company Employs Trucks Successfully

The entire output of the sand and gravel produced by the Acme Gravel Co. of Indianapolis is disposed of to Indianapolis contractors, and J. L. Alley, president of the company, says it has not been necessary to ship any of his product, although he has a railroad spur on his property.

Service Trucks make his deliveries. They are used instead of horse-drawn equipment on account of their economy of operation, convenience in loading and unloading and the saving of expense. "By the use of Service Trucks last winter," said Mr. Alley, "I was able to operate my plant during the most of the season and make deliveries in such manner that I am convinced this alone is responsible for the volume of business we are doing. It is some considerable satisfaction to a contractor who is wanting to do some particular bit of construction during a short non-season period in the winter months, to have sand and gravel dumped on the job at the time it should be there. Last winter, we had such orders, week after week, and because of the Trucks, we were able to make deliveries promptly. The result is apparent to me. Contractors in Indianapolis have come to believe in our delivery system and rely upon it. We do not take orders we cannot fill, but we take more orders than we possibly could fill if we used a team and wagon."

A Record for Low Upkeep Expense

A distance of 12,000 miles for a period of 12 months with an upkeep expense of but 15 cts. was the record recently made by a 2-ton pneumatic-tired truck of the Detroit Gear & Machine Company, Detroit.

The only expense of 15 cts. was for repairing a broken fan belt. The record was made by a Federal truck and was available through the accurate records kept by this company of costs of operation.

The records show that the total cost per mile for this 2-ton truck was but 32 cts. and their cost per ton mile but 40 cts. They got 10 miles to a gallon of gasoline with capacity loads all the time.

The work of the company is all city hauling, the greater part of which consists of short hauls to the freight depots and deliveries to local concerns using the product of the company. The truck has made from 10 to 12 round trips per day, including 14 or 15 short pick-up trips.

Handling Surplus Army Trucks in Illinois

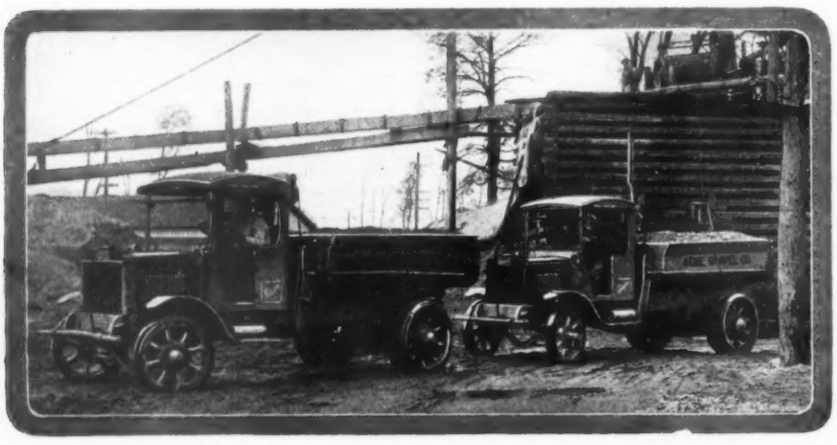
The following information on the distribution of surplus army trucks in Illinois is taken from the Illinois Highway Bulletin, issued by the State Division of Highways, on Aug. 7, 1920:

After the close of the war Congress passed an Act providing for the distribution of suitable road building equipment by the War Department, through the Secretary of Agriculture, to the various states. This Act provided that such equipment could be used only in the construction of Federal Aid roads. In accordance with this Act and up to the present time the State of Illinois has received about 775 serviceable motor trucks.

Early in 1920 Congress passed an amendment permitting the various states to lease this equipment to counties or other municipal bodies for road work, removing the restriction on their use for Federal Aid roads only.

This enabled the department to allot to the various counties of the state some 400 motor trucks; about half of this equipment was new when received by the state and one-half had been used in the army. The allotment to the counties was made partly in proportion to the road mileage in the county and partly in proportion to the assessed valuation of the county. Up to the present time more than 100 trucks have been turned over to counties under this plan which provides that the county itself or any municipality may, by entering into an agreement with the state, receive one or more of the motor trucks which were included in the original allotment to the county.

The Federal Act providing for this distribution is very explicit in requiring that the title of the trucks remain with the state, and that the trucks shall not be leased to any township, city or municipality at a less rental than that necessary to keep the truck in repair. The state, therefore, is charging a rental for these trucks including a small fixed sum to cover the cost to the state of freight and handling, and a small yearly sum to cover the general inspection of this machinery, the municipality being expected to maintain the trucks in good repair.



SERVICE TRUCKS AS OPERATED BY THE ACME GRAVEL CO., INDIANAPOLIS, IND.

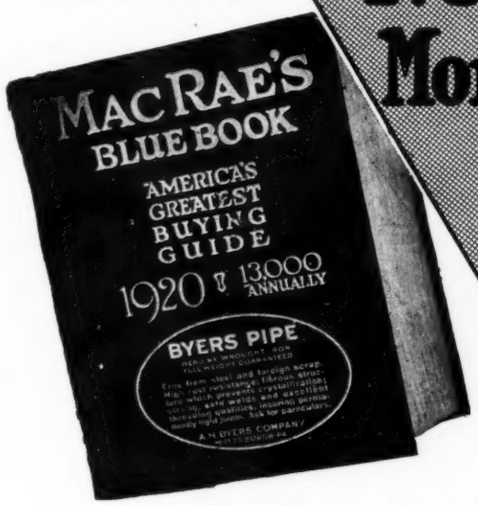
"America's Greatest Buying Guide" Opens New Sources of Supply For Material You Buy Every Day

How are you going to keep your plant supplied the coming year? Last year you had trouble—everyone did. Coal strikes, railroad embargos, and universal under-production cut many an old source of supply off last year. Have we any assurance conditions will be better this year?

You can know instantly and absolutely your nearest source of supply of any material you need. If freight embargos cut you off from your accustomed sources you can immediately, without delay, find new sources of supply in another part of the country. You can know *all* the manufacturers of materials you buy in order to get competitive bids. You can find all this and more in the 1920 edition of

Over 2,000 pages

Over 35,000 M'f'rs. Listed



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—an eleven pound book of over 2,000 pages that needs no introduction to over 50,000 past users including the largest buyers in the country — railroads, the navy, steamship lines, construction companies, and manufacturers in all lines. Mr. J. de Josez, State Civil Engineer in charge of Belgian reconstruction used it to find supplies in America.

Takes the Place of 160 ft. of Bookcases

To have the buyer's information contained in this single volume in the next best form, you would need a collection of over 2,000 manufacturers' catalogs that would occupy 160 feet of bookcases and require all of one girl's time filing, indexing, and cross-indexing. Think of this saving with MacRae's Blue Book. Think of having in one volume all the market for all the items you purchase or might need. Think of the convenience of being able to instantly find the name of a manufacturer when you only have his product's trade name. Think of the advantage of having the nearest branch office address and manager's name of any company you order from. Think of the saving in time on rush orders.

MacRae's Blue Book is the most compact, complete, and convenient index to American industry published today. A book that saves many times its cost for every owner.

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Arranged in alphabetical order, the names and addresses of 35,000 of America's leading manufacturers, showing branch offices.

Indexed under 14,000 classifications of material, and supplies the names and addresses of these 35,000 manufacturers with brief selling talks.

An alphabetical index of trade names of materials and the names and addresses of the manufacturers thereof.

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Standard List Price Section. This is a special, copyright feature. Herein are listed and conveniently indexed all standard list prices on commodities in common use by railroads and industrial concerns. A net discount computer is another time saver.

The "Selling Talk" of almost 2,000 of America's leading manufacturers conveniently arranged and indexed.

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A limited number only have been printed and to be sure of yours, send the coupon at once. When you get the book, if you are not entirely satisfied that it will save you time, labor and money, return it to us and there will be no charge made to you. If we do not hear from you in ten days we will bill you for $10.00 — the price of the book.

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Gentlemen: Send us.....copies of the 1920 Edition of MacRae's Blue Book. If we are not entirely satisfied with the books we will return them in ten days at your expense and you are to make no charge against us. If we decide to keep the books, you can bill us $10.00 per copy—the price of the book.

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Per..... Title.....

No. of books wanted.....

The trucks are virtually the property of the county or municipality, although the title remains with the state, as the agreement with the county or municipality provides that the trucks may be retained as long as they are kept in serviceable condition and are used on the public roads or streets. This requirement is only that specified in the federal law and cannot be avoided.

A Recent Traffic Census in Pennsylvania

The following statement of results of a recent traffic census in Pennsylvania is interesting as showing the comparative volume of motor and horse traffic: A traffic census taken on sections of the Lincoln Highway and the Wliliam Penn Highway, Sunday and Monday, July 25 and 26, was a revelation to the State Highway Department. At ten points on the Lincoln Highway on the two days mentioned 32,531 vehicles of all kinds were counted; and on three sections of the William Penn Highway the number of vehicles on those two days totaled 8,077.

The heaviest traffic was found to be traveling the Chester County section of the Lincoln Highway between Coatesville and Downingtown. On Sunday, July 25, 3,877 passenger cars were counted on this thoroughfare, while the number of trucks was 82. On the following day, Monday, the number of passenger cars fell to 2,307, while the truck total jumped to 1,013. On Sunday 125 motorcycles passed over this road, but on Monday the number had decreased to 43. There were 33 teams on Sunday and 74 teams on Monday. The total number of vehicles counted on the Coatesville-Dowingtown road on Sunday and Monday was 7,554.

William Penn Highway traffic was counted between Bethlehem and Easton, between Lewistown and Mifflintown, and between Lebanon and Reading. The heaviest traffic was on the section in Northampton County between Bethlehem and Easton. On Sunday, July 25, the passenger cars using this roadway totaled 3,243 and the trucks totaled 75. On the following day 1,002 passenger cars were counted, and the number of trucks totaled 270. There were 159 motorcycles on Sunday and 60 on Monday; eight teams on Sunday and 25 on Monday. The total number of vehicles for the two days was 4,842.

The section of the William Penn Highway between Lewistown and Mifflintown was oiled several days prior to July 25, and traffic, consequently, was not so heavy as ordinarily, but on Sunday, 611 passenger cars were counted on the 11 mile strip between these two towns. On Sunday there were only two trucks. The number of passenger cars on Monday had decreased to 206 and the trucks increased to 24. The total of all classes of vehicles on this section for two days was 960.

On Sunday, July 25, 1,431 passenger cars were counted on the thoroughfare between Lebanon and Reading, and 34 trucks. On Monday the number of passenger cars had decreased an even thousand to 431 and the trucks increased to 105. A total of 148 motorcycles was counted on Sunday, and 23 on Monday. The teams counted on Sunday were 30, and on Monday 73. For the two days the total number of vehicles of all kinds was 2,275.

The heaviest team traffic counted in the two days was between Philadelphia and Morrisville, 117 teams using that section on Monday, and 54 on Sunday. The largest number of motorcycles was also counted on this strip, there being 343 in two days. By far the heaviest truck traffic occurred on the Philadelphia and Morrisville section, 546 trucks being counted on Monday and 265 on Sunday. The number of passenger cars on Sunday was 2,647 and on Monday 922.

Traffic on the western Pennsylvania sections of the Lincoln Highway was not so heavy as on eastern sections On Sunday between the Allegheny County line and Greensburg 2,147 passenger cars and 37 trucks were counted; and on Monday the number was 920 passenger cars and 188 trucks. On Sunday only one team was counted and on Monday only five. From Greensburg east to the Westmoreland County line 2,027 passenger cars, 32 trucks, 149 motorcycles, and 22 teams were counted on Sunday; and on Monday there were counted 644 passenger cars, 103 trucks, 33 motorcycles and 20 teams—a total of 3,030 for the two days.

The census showed the least travel to be covering that section of the Lincoln Highway between the town of Bedford and the Fulton County line. On Sunday, July 25, there were counted 690 passenger cars, 51 trucks, 28 motorcycles, and 17 teams; and on Monday the vehicles were 285 passenger cars, 101 trucks, 11 motorcycles, and 47 teams—a total of 1,230 for the two days. Between the town of Bedford and the Somerset County line on Sunday the count showed 845 passenger cars, 29 trucks, 41 motorcycles, and six teams. On Monday there were 475 passenger cars, 19 trucks, 13 motorcycles, and seven teams—a total of 1,435 for the two days.

Sunday traffic was also heavier in Lancaster County than the count for Monday. Between Columbia and Lancaster on Sunday there were 1,722 passenger cars, 44 trucks, 76 motorcycles, and 22 teams, while on Monday the passenger cars totaled 460, trucks, 115; motorcycles, 22; and teams, 26; or a total of 2,487 for the two days. From Lancaster to the Chester County line the Sunday count was 1,356 passenger cars, 31 trucks, 70 motorcycles, and 34 teams; and the Monday count was 560 passenger cars, 57 trucks, 32 motorcycles, and 13 teams, or a total of 2,153 for the two days.

At a point west of York for the two days there was a total of 1,858 passenger cars, 197 trucks, 85 motorcycles, and 64 teams, or a total of 2,204. On this strip the number of passenger cars on Sunday was over a thousand greater than on Monday.

In Chester County the count between Philadelphia and Paoli on Sunday showed 130 passenger cars, 33 trucks, 79 motorcycles, and 11 teams; and on Monday, 507 passenger cars, 226 trucks, 42 motorcycles, and nine teams—a total of 2,210.

For the two days the count on the Bucks County road

between Philadelphia and Doylestown showed 1,894 vehicles of all kinds.

The two-day count showed that on the ten sections of the Lincoln Highway, Sunday and Monday, there were 27,241 passenger cars, 3,270 trucks, 1,368 motorcycles, and 652 teams. On the three sections of the William Penn Highway there were 6,924 passenger cars, 510 trucks, 495 motorcycles, and 148 teams.

Of the 34,165 passenger cars using the William Penn and the Lincoln Highways, 24,719 were counted on Sunday.

Of the 3,780 trucks which used these two roadways, 3,000 were counted on Monday.

The count for both highways on the two days showed a total of 40,608 vehicles of all classes, as follows: passenger cars, 34,165; trucks, 3,780; motorcycles, 1,863; teams, 800.

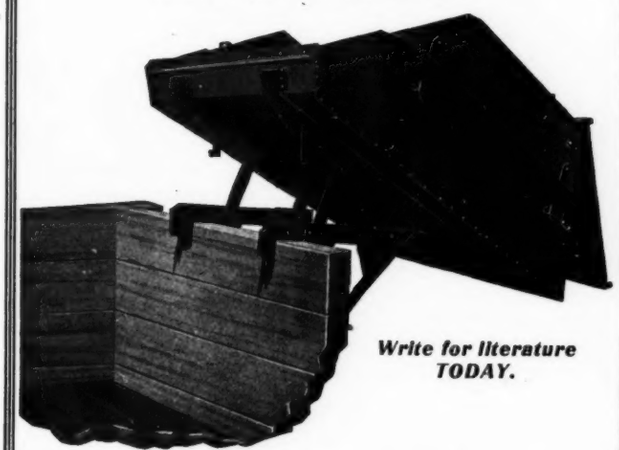
Earnings of Some Mack Trucks

A 3½-ton Mack operated by the Dempster Construction Company of Knoxville, Tenn., produces for its owners, a net revenue of $130 per day, which represents an actual saving of $60 per day for the same work done by teams. Two Mack 2½-tonners are doing the work of 20 teams for A. E. Buck of East Arlington, Vt., and a report from R. W. Walker of Salisbury, N. C., says that his 7½-ton Mack is doing the work of 12 teams at one-third the cost. The Mooresville Furniture Co., also in Salisbury, N. C., has saved $20 a day by using a 7½-ton Mack and the truck paid for itself long ago.

Mr. Dan Tankersley, Sapulpa, Okla., wired **"Heltzel 'Lightning' Loader Skips giving perfect satisfaction."**

The ever increasing number of satisfied buyers prove the **"Lightning"** Loader Skip is a necessary piece of equipment for unloading open cars.

$60.00, 1 cubic yard size
70.00, 1½ cubic yard size



Write for literature TODAY.

The Heltzel Steel Form & Iron Co.
WARREN, OHIO.

GARFORD

Clear the Terminals!

The use of motor trucks at railway terminals will free thousands of freight cars for active use in the present traffic tie-up. Terminal congestion is the chief cause of our clogged transportation system. Without distribution business stagnates. Motor trucks can and will relieve this condition.

America's leading statesmen, financiers and railway officials urge wider use of the motor truck.

Transportation or Stagnation?

Keep the Traffic Moving

TRUCKS

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

ACME TRUCKS

"Sure Fire"
Haulage Service

Continuity of Service was the first requirement of the Harrison Land Company. They needed haulage units that would deliver steadily, day after day, with no costly delays; so they chose three Acme Trucks shown in the illustration.

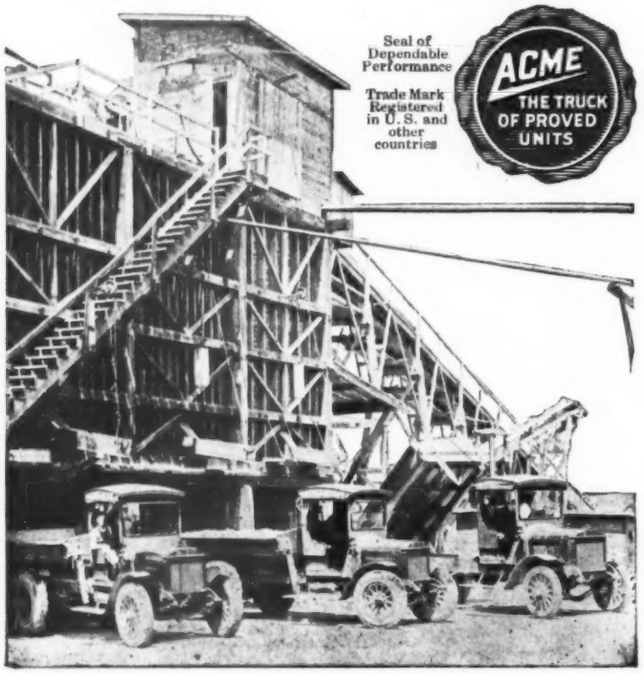
As usual, Acme transportation has meant uninterrupted haulage service to the Harrison Land Company. The trucks keep going every day, working on definite running schedules which are strictly adhered to. Acme has made transportation a definitely calculable factor — and contractors know the value of eliminating uncertainty from their haulage operations.

Over 21% of all Acme Trucks go into the contracting and engineering service. Here, as in no other field, is a truck called upon to demonstrate its true worth and stamina. And "proved units—Acme constructed" never fail to measure up to the task, whatever it may be.

Write for complete information

Built in 1, 1½, 2, 3¼ and 5 ton models

ACME MOTOR TRUCK CO.
318 Mitchell St. Cadillac, Mich.



HAUL IT IN A HALL

Hall Trucks are the development of forty-six years experience in the fabricating and transportation of structural steel

Rugged Strength a Feature of Hall Trucks

HALL users invariably comment on the excess strength of Hall Trucks, and on their economy of operation.

Now these two features are characteristic of Hall Trucks. They are the result of exceptionally high standards of workmanship and of unusual engineering skill.

You will find that Hall Trucks embody sound, use-tested and time-proven engineering principles. They are not experimental in any sense.

From the users point of view this means that Hall Trucks will always stand up and give practical, enduring, economical service. They never develop unsuspected weaknesses or defects—because every Hall Truck is correctly designed and honestly constructed.

One or the other of the various Hall models will be found to be entirely suitable for your kind of work—and whatever model you get you can always be sure of Hall quality in every part and in every detail.

Write us direct for complete details and the name of the Hall dealer nearest you. Address Department 23.

LEWIS-HALL MOTORS CORPORATION
DETROIT, MICHIGAN
Formerly Motor Truck Division of the Lewis-Hall Iron Works

2½, 3½, 5 to 7 Ton Models. Any type of body.

HALL TRUCKS

EDITORIALS

ADVERTISING SIGNS ON PUBLIC HIGHWAYS

Among many highway officials there is a deep-seated dislike and open hostility to advertising signs on public highways and this feeling is undoubtedly shared by many users of the highways. Certain aspects of this matter merit attention.

Recently the chairman of a County Board of Supervisors issued the following notice to the merchants of the county: "All advertising signs on Primary and Secondary roads in this county must be removed on or before the first day of August, 1920, or same will be torn down by the county."

Two counties in the state have taken this action at this time and every county in the state is being urged to take similar action by the State Highway Commission, we infer from an article on the subject published recently in the Service Bulletin of the Commission.

The officials of one county asked the Attorney General of the State if they had the right to tear down the signs and his office ruled that their right to do so was beyond dispute. In substance the ruling was: That a public highway from side to side, and from end to end, belongs to the public, and an obstruction need not entirely block traffic to become subject to removal. It is classed as an obstruction if it is an impediment or hindrance which tends to interfere with free passage along the highways. Further, no person has a right to appropriate a part of the highway by using it for the posting of signs or advertising matter.

To quote from the Service Bulletin: "The Highway Commission in 1913 put the ban on the advertising sign on bridge and culvert structures and frowned on its use on any part of the right of way. From time to time various counties have issued orders forbidding the erection of such signs. Recently on federal aid projects it has ordered all signs torn down. Public sentiment seems now to have reached the point where the more general action started by (the two counties) backed up by the action of the Attorney General's office, may become effective in starting a final effort to drive this nuisance entirely off the right of way. There is still no way to prevent the erection of signs on the private property adjoining the highway. Only public sentiment and the right spirit of the private land owner can prevent this. Here's to (the two counties) and may every county in the State follow in their footsteps!"

With respect to the foregoing we offer the suggestion that the counties, in acting in this matter, have need of a sign reading: "Watch Your Step."

That advertising signs on the public highways are often unsightly is not denied. Sometimes they obstruct the view on curves and very often they confuse the tourists in their precise but inaccurate mileage markings. They probably do, at times, constitute obstructions to a free passage along the highways, while at other times they aid it. The problem is one calling for regulation, however, rather than prohibition.

It is well for highway officials to bear in mind that these signs are paid for by worth-while people; the sort of people who count in every community. Local merchants have used roadside signs since memory runs not to the contrary and it remained for the newspapers to discover all the unlovely aspects of billboards and outdoor sign advertising. The newspapers were not moved to prolonged outbursts against advertising signs, however, until national advertisers began to make use of them. Then all the bad things about the signs became apparent to the newspapers, all but one of which were discussed for the edification of newspaper readers. The point reserved was that every dollar spent on an advertising sign was being diverted from the potential income of the newspapers. There have been many newspaper editorials written to discourage the use of billboard and outdoor sign advertising, ostensibly to safeguard a variety of public interests, but actually to increase newspaper advertising revenue. Quite likely the users of advertising signs appreciate this fact and it may irritate them to see highway officials playing the newspapers' game, whether innocently or not.

In the great highway movement the support of local merchants is invaluable. Let us not place this support in jeopardy by arbitrarily ruling all advertising signs off the highway while expressing regret that they cannot be removed from adjoining private property at the same time.

As we have suggested there is need for censorship of highway sign advertising, but we doubt the wisdom of prohibiting the use of all such signs without respect to the location, nature and appearance of the individual sign. Some advertising signs are useful to the tourist, either wholly or incidentally, and they should not be removed without specific cause. Some signs are actually ornamental for even the face of nature is not beautiful in all its features.

CO-OPERATION IN TRANSPORTATION

The keen edge of cut-throat competition in transportation has been dulled. We refer, of course, to competition between the various forms of transportation rather than to that between carriers in the same class. Even the steam railroads seem anxious to show themselves friendly and to conduct their affairs in a neighborly manner. All this was very evident at the recent meeting called in Akron by the Federal High-

way Council. While primarily this was a national good roads conference it was attended also by representatives of steam and electric railways, waterways and express companies. In sending their representatives to this conference the managers of the other forms of transportation signified their willingness, for the present at least, to co-operate with highway interests in the coordination of transportation agencies. The conference was a veritable love feast with each interest anxious to commend and compliment every other.

Now, it is never our desire to take an ungenerous view of anything or anybody but we admit a long-standing and deep-seated distrust of the steam railway interests. Perhaps this feeling was gained in the service of three prominent railroad companies. At any rate we are quite sure that if any advantage accrues to other forms of transportation from the present tolerant attitude of the railroads it is well to realize all we can on this disposition toward cooperation, lest it be discarded for one of ruthless and destructive competition.

A prominent railway manager, speaking at the Akron meeting, expressed the opinion that rail transportation cannot be brought up to standard in less than five or six years from date. And even this accomplishment must rest largely on favorable circumstances and generous treatment.

Such being the case, highway interests have five or six years in which to operate unopposed by railway interests. Let no one doubt if the railway managers ever begin to feel highway competition they will oppose the highway movement with every force at their command. And the railways can, on occasion, muster a very formidable war machine as every initiated person knows. (It wasn't an accident that waterways went out of fashion for many years.) Just now the railroads stand, hat in hand, protesting their good character and good intentions and asking for one more chance. Perhaps it is very unbecoming in us but we confess that their present attitude persistently reminds us of: "The devil he got sick; the devil a saint would be. The devil he got well; the devil a saint was he."

Viewing the history of railway operations, off the right of way, as charitably as one will, a truly Elizabethan genius for dissimulation is disclosed at many points. Just now the railroads are, in a manner of speaking, under parole and they want to be very, very good. However, such are the imperfections of the world that it might, conceivably, come about well within the next ten years that they would consider it expedient to oppose the further development of the highways. If there is anything in this prospect it behooves the highway workers to make all possible progress during the period of minimum political opposition, especially in matters of legislation and taxation.

INSPECT THE OLD BRIDGES

A great deal has been written of late years about the effect of modern motor traffic on roadways and it is quite as important to realize that modern traffic is subjecting many existing bridges to stresses much greater than were provided for in the original design. Only the liberal factor of safety used in bridge work has prevented many serious bridge failures under the very common heavy live loads of today. Many bridges are in service which were designed to carry light, horse-drawn vehicular traffic and a concentrated traction engine wheel load. Subject such a structure to a full load of heavy truck traffic and a dangerous situation is produced; a situation dangerous alike to life and property:

In a timely contribution to this issue an engineer calls attention to this very real danger and cites specific examples of the danger inherent in loading old, badly deteriorated structures with loads greatly in excess of what the bridge was designed to carry when new. New flooring systems, being a part of the roadway, have been put in to serve modern traffic needs and these nearly always add to the dead load to be carried.

There is need of alertness with respect to old highway bridges. Let us prevent failure by anticipating them. Any bridge built for the lighter traffic of former times and now called on to carry present day loads should be looked upon with suspicion until a competent bridge engineer inspects it and pronounces it safe. Bridges on state highways are undoubtedly being looked after by the bridge engineers of the state highway comissions and it is only fair to assume that bridges in the large cities are also being checked up. But there are many bridges in villages and small towns on which outside talent must be engaged for the sake of safety.

BRICK PAVEMENT SPECIFICATIONS

Designers and builders of brick pavements are very appreciative of the specifications for brick pavements on city streets and county highways recently issued in convenient form by the National Paving Brick Manufacturers Association. Engineers especially appreciate the compliment to their skill and the deference to their judgment and prerogatives which are silently but eloquently expressed in the form in which the specifications are issued, for types of brick pavements are not specified. Instead, the component parts of brick pavements of all types are treated separately and the engineer is offered a specification for each part. In designing he is left free to combine these parts to form a complete pavement structure such as he deems suitable in the light of local conditions and requirements. The work reflects the modern practice in brick pavement construction. It is a manual of recommended practice. It is not offered to the profession as an expression of finality, for developments in the art are always in prospect, but it unquestionably records the advanced thought on the subject. This is not the place for an extended review of the work but it impresses us as of such character and quality as to merit special commendation. We have had unusual pleasure in adding it to our library.

Design and Construction of Brick Roads in Reno County, Kansas

By M. W. Watson, State Highway Engineer, Topeka, Kans.

When the word Reno is mentioned the mind usually pictures that far western city where the troubles of married life are easily cast aside. To the road-building industry of Kansas this word has an entirely different meaning. We at once think of a certain county located in the broad Arkansas river valley just west of the sixth principal meridian, slightly rolling and having a sandy loam soil. It is one of the largest wheat growing counties of the state, which usually outranks the other forty-seven states in the production of this very esential food product. The mineral resources of the county should not be overlooked, for within the county is located one of the largest salt mines in the middle west. Hutchinson, the county seat and principal city, is often termed the Salt City of the West.

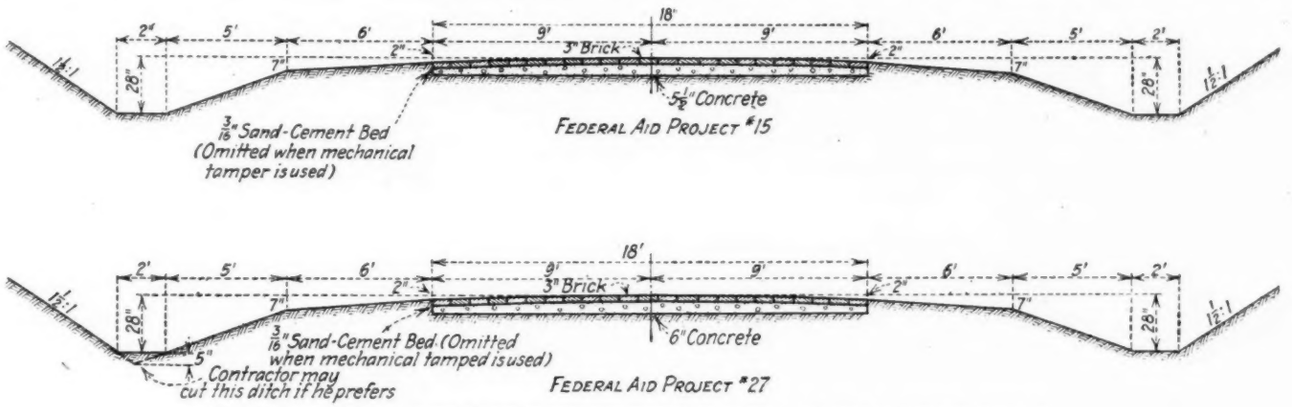


FIG. 1. TYPICAL CROSS SECTION OF RENO COUNTY, KANSAS, BRICK ROADS.

Reno County Has 74-Mile Brick Road Program

The progressive farmers and business men of this county decided that the one thing necessary to its advancement was the construction of a system of real hard surfaced roads. They took advantage of the Benefit District law and formed districts for the improvement of 74 miles of road with a brick surface. To date the contract has been awarded covering 37.55 miles of 18 ft. monolithic brick. The remaining miles are ready to be let as soon as conditions will permit.

Like a large part of the Arkansas river valley this county is underlaid with fine gravel and sand. There is no stone suitable for road building found in the county and the difficulty of securing adequate transportation for shipping materials renders it necessary to untilize local gravel.

Design Features

The road from Hutchinson northwest through Nickerson,, being located through a very sandy loam soil, offers exceptional opportunity for drainage and a uniform subgrade. For this reason the base was designed to be 3½ ins. thick on the sides and 5½ ins. in the center, using a 3-in. vertical fiber brick as a wearing course. On the remainder of the work the base is designed ½ in. thicker than on project 15. The type of construction selected is monolithic brick.

The concrete base is specified to have a mixture of one part cement, three parts fine aggregate and five parts coarse aggregate, or in the event a combined aggregate is used the mixture must give an equivalent strength to a 1:3:5 mix. The strength of a 1:3:5 mix is fixed according to the joint committee recommendation at 1,600 lbs. per square inch in compression. After extensive tests the following table of proportions was devised for use as the equivalent mix, everything passing a ¼-in. screen being considered as fine aggregate and all retained as coarse aggregate.

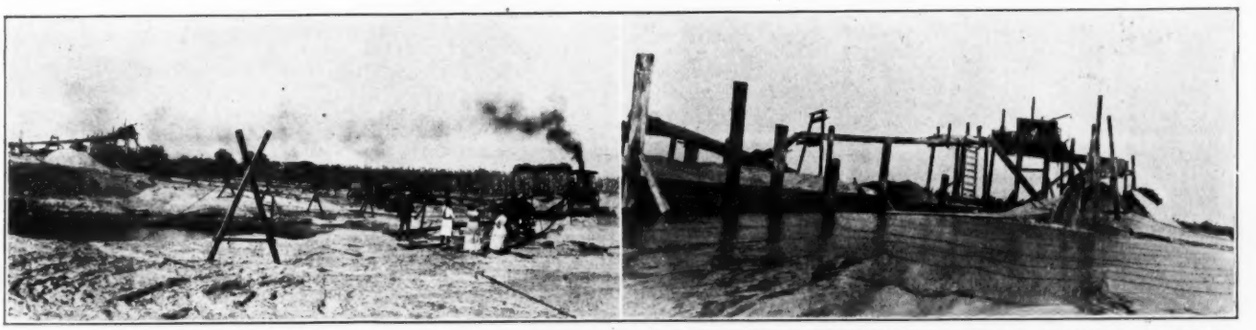
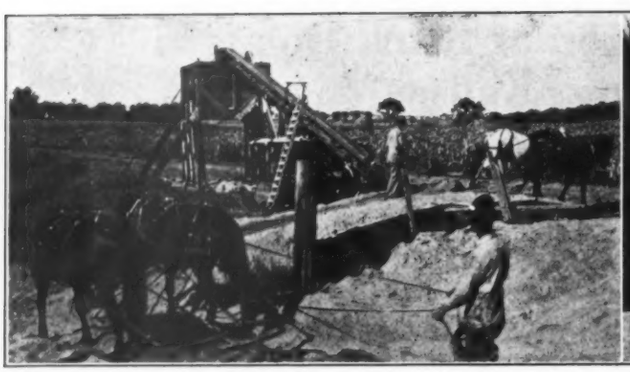


FIG. 2. PUMPING PIT GRAVEL FOR USE IN CONCRETE BASE FOR BRICK HIGHWAY IN RENO COUNTY, KANSAS.
FIG. 3. GRAVEL SCREENING PLANT USED ON RENO COUNTY WORK.



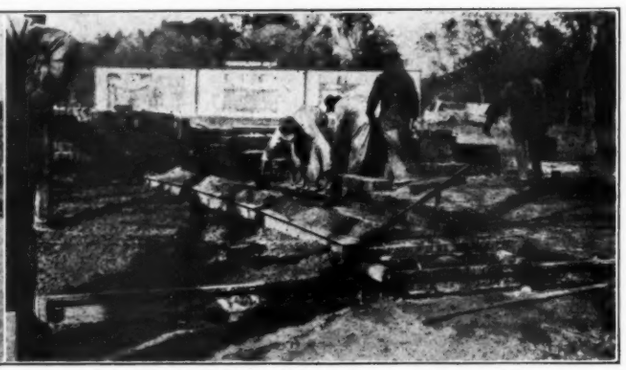


FIG. 4. LOADING GRAVEL ON RENO COUNTY WORK. FIG. 5. PARRISH TEMPLATE USED ON CONSTRUCTION OF RENO COUNTY MONOLITHIC BRICK PAVEMENT.

Per cent. of gravel retained on a ¼-in. screen.	Proportions by loose volume. Cement		Gravel
0 to 10	1	to	4
10 to 15	1	to	4½
15 to 25	1	to	4¾
25 to 35	1	to	5
35 to 45	1	to	5¼

The bulk of the coarse aggregate passes a 1-in. screen.

Construction

In the beginning of the work the base was poured at a stiff consistency and struck off by the Parrish type of multiple steel template, using a 3/16-in. dry sand-cement bed. The brick were laid direct on the sand-cement bed before the base attained its initial set. The gravel aggregate, containing very little coarse material, produced a concrete with which it was difficult to obtain satisfactory results. When mixed sufficiently dry to permit the other operations it contained too little water properly to saturate the dry cushion, with a consequent separation between the base and brick surface. When made with enough water to give the dry cushion a proper amount of water, due to the absence of coarse material, the concrete had little stability, rendering the operations of rolling and grouting exceedingly difficult and making it almost impossible to secure a smooth surface. This trouble has been overcome by the use of a mechanical tamping machine operated directly on the base and the elimination of the sand-cement cushion. A marked improvement is noted by reason of this change. Rolling is done by means of a hand roller and the joints are grouted with a 1 to 1 mortar in three applications.

CONTRACT PRICES ON BRICK ROADS IN RENO COUNTY, KANSAS

Items	PROJECT NO. 15 SECTION A	B	C	PROJECT NO. 27 SECTION A	B	F	G
Contractor	Stamey & Mackey Cons. Co.	Stamey & Mackey Cons. Co.	Wheeler & Keleher Cons. Co.	Wheeler & Keleher Cons. Co.	Wheeler & Keleher Cons. Co.	Stamey & Mackey Cons. Co.	Stamey & Mackey Cons. Co.
Contract Awarded Date	Oct. 10, 19	May 12, 19	May 12, 19	Oct. 10, 19	Oct. 10, 19	Oct. 10, 19	Oct. 10, 19
Mileage	7.093	5.481	4.997	5.004	5.520	5.014	4.443
Average Haul (Miles)	½	1½	1½	2	4	8	8
Excavation in Earth	$0.80	$0.60	$0.70	$0.97	$0.85	$0.75	$1.00
Borrow in Earth	0.60	0.50	0.60	0.60	0.60	0.60	0.60
Monolithic Brick	3.85	1.40	1.30	3.92	4.15	4.30	3.75
Class A Concrete	35.00	15.00	10.00	35.00	35.00	35.00	30.00
Reinforcing Steel	0.07	0.06	0.10	0.07	0.07	0.07	0.07
Lin. Ft. Guard Fence	1.10	.....	.....	.....	.....	.....	.....
Small Trees	.....	2.00	1.00	.....	.....	.....	.....
Large Trees	.....	10.00	10.00	.....	.....	.....	.....
Rods of Hedge	.....	4.00	2.00	.....	.....	.....	.....
Section Markers	.....	45.00	45.00	.....	.....	.....	.....
Stumps	.....	10.00	5.00	.....	.....	.....	.....
Raising Bridge Floor	400.00	.....	.....	.....	.....	.....	.....
Handrail Concrete	.....	.....	.....	40.00	40.00	35.00	45.00
Cost Slab, per mile	$40,873.00	$32,110.00	$33,095.00	$37,426.00	$43,962.00	$45,407.00	$39,774.00
Cost of Job, per mile	$47,998.00	$35,658.00	$37,335.00	$45,446.20	$50,942.26	$57,895.00	$46,131.00

Materials furnished by County. Cost of following Unit Prices not included in this price. Brick F. O. B. Plant @ $0.98 per Sq. Yd. Freight rate 9½c per 100 pounds. Cement F. O. B. Plant @ $2.50 per bbl. Gross Freight rate 12½c per 100 pounds. Gravel @ 25c cu. yd. in Pit.

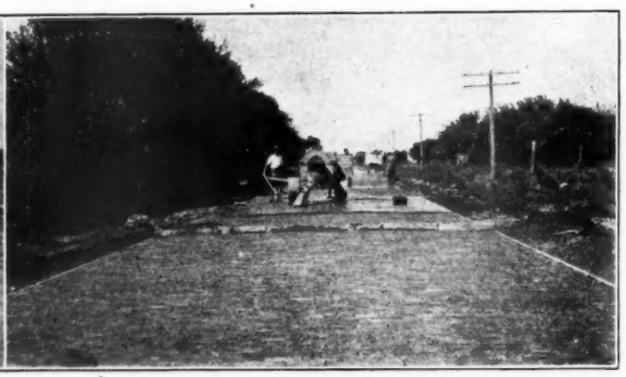


FIG. 6. LAYOUT OF RENO COUNTY MONOLITHIC BRICK PAVING JOB SHOWING USE OF TEMPLATE, STEEL SIDE FORMS AND GRAVITY BRICK CONVEYOR.

No expansion joints are used and all construction joints are reinforced with ½-in. bars, 12 ins. center to center, in order to reinforce these points, which are believed to be weak points in the base construction.

An inspector is kept both in front and behind the mixer. One is employed continuously to check the proportioning of the concrete, which is varied continually to furnish the proper mix. The gravel is pumped and screened to remove a portion of the fine aggregate before loading, but the disposal of surplus fine material is considered to be in excess of the extra cost of cement required.

The names of the contractors and contract prices for the different projects and sections are indicated in the accompanying table.

Payment

Federal aid has been granted on the sections awarded at the rate of $15,000 per mile. After deducting the amount of federal aid for each district, the cost will be distributed 50 per cent to the county, 25 per cent against the townships in the benefit district, in proportion to the land of the district in each; the remaining 25 per cent is charged to the property in the benefit district, according to the benefits accruing.

U. S. TESTS SHOW ROAD WEAR AND RESISTANCE

Such important questions as how hard a heavy motor truck pounds a pavement when going at five miles an hour and at 15 miles an hour are being answered by investigators for the Bureau of Public Roads, United States Department of Agriculture, in a series of scientific experiments, which, when completed, promise to be of great value to highway engineers. Already sufficient tests have been made to show that increased speed of a vehicle equipped with hard rubber tires tremendously increases the impact which its wheels make on the roadway where there is any unevenness. On the other hand, where pneumatic tires are used increased speed adds comparatively little to the impact. It has been suggested that these tests will be of great value not only in settling questions of design but may also lead to a rational basis for determining license fees for motor vehicles.

Trucks have been used in these tests varying in size from a 1-ton truck up to a 7½-ton truck carrying an excess load. Each truck was run over a special recording device embedded in a roadway and the impact which resulted when one of the wheels made a 2-in. drop from a ledge built in the surface caused the deformation of specially prepared copper cylinders forming part of the apparatus. The magnitude of the blow was accurately ascertained in pounds by measuring the extent to which the cylinder had been forced out of shape.

Tests Show Value of Pneumatic Tires

Recent tests were made with a 3-ton truck of well known make loaded with a 4½-ton load so that the total weight on each rear wheel was 7,000 lbs., the unsprung portion (that not supported by the springs) being 1,700 lbs. and the sprung portion (that portion supported by the springs) 5,300 lbs. The truck was equipped first with an old solid tire that had been worn down to a thickness of 1 in. Then, with exactly the same load on the truck, a wheel was used fitted with a new solid tire 2½ ins. in thickness. And finally, the truck was equipped with pneumatic tires 42 x 9 ins. and blown up to a pressure of 142 lbs. per square inch. The following table shows very clearly the bad effect an old tire is likely to have on a road surface and the greatly lessened impact produced by trucks when they are equipped with pneumatic tires. The tests show that as the vehicle's speed increased the impact from the old hard rubber tire increased greatly. The impact from the new hard rubber was somewhat less.

Approx. Speed	Height	Old Tire	New Tire	Pneumatic Tire
5.7	2 ins.	11,600	9,400	7,100
10.2	2 ins.	18,500	14,100	7,800
14.6	2 ins.	26,500	18,700	8,300

Testing Paving Slabs

Related to these tests is another series which utilizes the figures secured in the first experiments. A number of paving slabs were tested by means of a machine designed to give impacts equivalent to those produced by the rear wheel of the heavy truck already referred to. The unsprung portion of the weight of this machine is 1,500 lbs. and the sprung portion weighs 6,000 lbs. The tests were made by raising the entire weight through a height of ⅛ in., allowing it to fall 500 times, then to a height of ½ in. with 500 repetitions, then ⅜ in. more in height, and so on until the slab failed. To date about 12 slabs have been tested, laid on a rather wet subgrade. A surprising difference has been found in the strength of the different types of pavements tested. The total number of blows required to cause failure have varied with the different slabs from 67 up to almost 2,000. All these data promise to be of the greatest value to engineers in selecting material for roads of various types.

Relative Wear of Different Pavements

The Bureau of Public Roads is also making a study of the relative wearing qualities of different types of pavements and tests have been about completed on a short section of pavement containing 49 different types subjected to the wear of a special truck equipped with five large cast-iron disk-like wheels. The relative wearing qualities of hard as compared with soft brick are brought out very distinctly in this test. The resistance to wear of various kinds of stone block sections is also shown up to good advantage. A chance to compare grout and asphalt fillers for both brick and stone block is furnished by this investigation. Likewise, the relative wearing qualities of concrete when mixed with various kinds of coarse aggregates is indicated.

Investigation of Subgrade Materials

The investigation of subgrade materials, started a few months ago with the co-operation of the District engineers and State engineers, is proceeding at a very satisfactory rate. A number of samples have been received from various parts of the country and laboratory analyses of many of these samples are partially completed. The methods being used by the Division of Tests will shortly be published as a paper so that any other laboratories wishing to conduct similar investigations may have

some guide as to the method of procedure being followed by the Bureau of Public Roads.

The samples analyzed have been taken from parts of the roads that have failed very badly as well as from adjacent parts of the same roads that have withstood heavy traffic successfully. It is hoped that by a comparison of the laboratory results on these samples with the reported behavior of the road in service differences in the subgrade materials will become apparent so that we will be able to say what physical characteristics soils must possess to give them high bearing value.

ILLINOIS SOCIETY OF ENGINEERS ANNOUNCES PRIZE TECHNICAL PAPER CONTEST

A prize technical paper contest, open to those who have been members of the society for not more than five years and to applicants for new memberships, has been announced by the Illinois Society of Engineers. Rules governing the contest are given herewith. Five cash prizes of $25 each will be awarded. The contest has been arranged as a part of the plan designed to make the Society of tangible interest and value to its members.

Rules and Information

1. The contesting author must be a member, or affiliated member, of the Illinois Society of Engineers for not more than five years on Jan. 1, 1921. Applications for membership in proper form submitted before Nov. 15, 1920, shall qualify contestants.

2. The papers may be on any technical subject naturally falling under one of the five following general divisions:

A. Drainage.
B. Roads and Pavements.
C. Sewerage.
D. Surveying.
E. Miscellaneous Civil or Municipal Engineering.

The contesting author shall indicate at the top of the first page of his paper in which of the five divisions he wishes to compete, but the judges shall have the right to classify it in another division if in their opinion it seems proper to do so.

3. A prize of $25 in cash and a certificate of merit will be awarded to the best paper in each of the five divisions—a total of $125. If in any division there are submitted two papers of equal merit, in the opinion of the judges, an additional prize will be offered.

4. A contestant may submit papers on more than one subject, but no contestant will receive more than one prize.

5. The length of papers shall be not less than 1,500 nor more than 2,500 words exclusive of illustrations and tables.

Papers Must Be Submitted by Nov. 15, 1920.

6. Each paper shall be sent by registered mail to E. E. R. Tratman, Secretary, Wheaton, Ill., on or before Nov. 15, 1920. Papers shall be typewritten on one side of plain paper (no letterhead) and shall not be signed.

7. Enclosed with the paper shall be a plain sealed envelope containing the full name and address of the contestant and the title of the paper.

8. The Secretary will place a key number on each paper received and submit them to the judges. The author's name will not be divulged until the decision of the judges has been reached.

9. The decision of a majority of the judges in making an award and interpreting the rules shall be final.

10. Rights of publication of all papers submitted is reserved by the Illinois Society of Engineers.

11. Prize winners will be announced and papers read at the annual meeting in Chicago, Jan. 26-28, 1921.

The Judges

The following have consented to act as judges in the contest:

Arthur N. Talbot, Professor of Municipal and Sanitary Engineering, University of Illinois; Edgar S. Nethercut, Secretary, Western Society of Engineers, and Samuel C. Hadden, Editor, MUNICIPAL AND COUNTY ENGINEERING.

THE REPAIR OF MUNICIPAL BRIDGES

By A. W. Consoer, of Consoer Engineering Co., 1654 Monadnock Block, Chicago, Ill.

It has frequently happened that bridge repairs, involving the replacement of a plank floor with a heavier type of floor, or even more extensive alterations have been attempted by municipal officials without securing engineering advice and with an utter disregard for the violation of certain basic principles of bridge design. The writer's firm was recently retained by a municipality to report on a bridge which was showing alarming evidence of structural weakness, and had been closed to traffic by the Village Board, pending an investigation, as it was quite apparent to even a casual observer that the bridge was a menace to the traveling public.

An Example of a Dangerous Bridge

The steel superstructure of the bridge consisted of three 74 ft. through Pratt Truss spans of five panels each, with an 18 ft. roadway and two 5 ft. sidewalks. The investigation showed that some six years previously an old plank floor had been replaced by an enterprising contractor with a floor made up of a concrete base, sand cushion, and creosoted wood block wearing surface. An examination of the roadway stringers showed that many of them had taken a permanent set. The concrete base was of exceedingly poor quality, and showed serious evidence of disintegration. The creosoted wood block floor had buckled in several places and there was real danger of the floor breaking through under the impact of a fast moving automobile or truck. In view of these facts the bridge was kept closed to vehicle traffic by erecting barricades and by removing part of the floor at each end of the bridge to make impossible the use of the bridge for vehicle traffic.

The plank floor for which the structure had been originally designed weighed approximately 14 lbs. per square foot, while the new floor weighed about 100 lbs. per square foot. The new floor had been installed upon the advice of the contractor, who was building a similar floor on a new bridge about a mile upstream. An analysis of stresses showed that with the creosoted wood block floor, the roadway joists could carry only a 3-ton motor truck

load without exceeding a unit tensile stress of 16,000 lbs. per square inch, and with no allowance for reduction of section due to rust or corrosion.

Repairing the Dangerous Bridge

Inasmuch as funds for the construction of a new bridge could not be obtained, certain repairs were recommended which would modernize the bridge to the extent of making it capable of carrying a 15-ton load or a uniform live load of 65 lbs. per square foot over the entire roadway and both sidewalks. The repairs included replacing the existing roadway joists with seven lines of 9 in. 21-lb. I-beams and two lines of 9 in. 5 lb. channels, riveting flats on the bottom flanges of the end posts and top chords to eliminate the effects of pin eccentricity, a thorough cleaning and painting of all steel work, and the construction of a new and lighter bridge floor, consisting of creosoted ship-lap and a 1 in. bituminous wearing surface.

There is every possibility that this bridge will be called upon to carry concentrated loads of 10 to 16 tons. The possibility that this structure will ever sustain a live load exceeding 65 lbs. per square foot over the roadway and sidewalks is decidedly remote, so that it seemed justifiable to proceed with the repairs outlined, although modern designing practice would prescribe a uniform load of at least 100 lbs. per square foot for a bridge of this type.

Investigate Effect of Modern Loadings on Old Bridges

Many bridges are still in service in prosperous municipalities that were designed to carry light horse drawn vehicles. In checking a number of old steel bridges for municipalities, it has been found that most of them are designed for a gross concentrated load of not to exceed 5 tons. Heavy motor truck loads as high as 18 tons are becoming more and more common in all villages and cities, particularly on routes of improved state highways or marked trails. The various state and county highway departments have succeeded in replacing many light, flimsy steel highway bridges with modern bridges, designed to carry present-day loadings, but there remains a large field of work in the repair or replacement of municipal bridges. Wherever possible new structures should be built, but where funds are limited, repairs should be made to reduce as far as possible the hazard from fast moving motor truck traffic. Where the repairs do not bring the capacity up to 15 tons (or other maximum load prescribed by statute) warning signs should be erected at each end of the bridge, giving the permissible loading.

Strengthening Old Bridges

It is frequently possible in the case of an old steel bridge to strengthen the floor system so as to carry heavy concentrated loads. The increased weight of the new floor system will, however, reduce the allowable uniform live load, but in many cases the truss systems will still be good for a live load of about 50 to 70 lbs. per square foot. To make such repairs is often justifiable as heavy concentrated loads are carried each day, while the uniform live loading is seldom realized, even in large cities. It is, of course, necessary to determine that the truss systems will carry the same concentrated loads that the new floor system is designed for.

Repairs or strengthening of old steel bridges should be undertaken only after a careful examination and stress analysis have been made. It is necessary to measure not only main dimensions and sizes of members, but dimensions and sketches of all details must be obtained as well, as it is frequently found by calculation that the strength of a certain connection or detail is the limiting factor in the load capacity of the structure. It is necessary also to make an estimate of the per cent loss of strength by corrosion of the various members and details of the bridge. Among other things it is important to note the position of pins with respect to the centers of gravity of connecting bridge members. As in the case mentioned above, it has frequently been found advantageous to eliminate the effect of pin eccentricity in the end posts and top chords of old steel bridges by riveting flats to the lower flanges of the channels.

The strength of a riveted connection in one case was increased by removing $\frac{5}{8}$-in. rivets one at a time, reaming out the holes, and driving $\frac{3}{4}$ in. rivets. In another case the strength of an I-beam floor beam was increased by riveting cover plates to the upper and lower flanges. A plate girder floor beam was converted into a truss by using two $1\frac{1}{2}$ in. rods for the lower chord and short I-beams for posts. In still another case it was found that the roller bearings at one end of a span were so jammed by accumulations of rust and dirt, that no movement could occur in warm weather, thus causing high temperature stresses. New end bearings were installed, and the space around the shoes was enlarged and arranged so that it would drain.

Not only the superstructure but the substructure also should be carefully investigated. It is sometimes desirable to replace the substructure and strengthen the superstructure, or it may be practicable to renew only the superstructure if the substructure consists of substantial masonry piers and abutments on good foundations. It is often a difficult matter to determine the condition of masonry piers and their foundations. A novel method was employed some years ago in the case of a bridge over the Illinois River at La Salle, Illinois. It was contemplated to build a new superstructure on the old piers and abutments, but there was considerable doubt as to the exact condition of the substructure. A well driller was hired to drill down through the piers. His operations disclosed the fact that the bottom of the masonry was some 12 ft. above river bottom, and that the stability of the piers was depending on the pile foundations, and the plan to use the old substructure was therefore abandoned.

File Corrected Original Drawings

A set of the original drawings of a bridge under investigation is a great help. It is seldom that any can be located, and if they are available, they must be used with caution, as frequently changes were made during construction which are not recorded on the plans filed.

ADVANTAGES OF SIPHON SPILLWAYS

By A. T. Mitchelson, Senior Irrigation Engineer, U. S. Department of Agriculture, Washington, D. C.

(Editor's Note: The following presentation on the advantages of siphon spillways is from Bulletin No. 831, issued under date of August 25, 1920, by the U. S. Department of Agriculture, entitled: Spillways for Reservoirs and Canals. The bulletin has chapters on: Spill-

ways, Overflow Spillways, Spillway Control, Flashboards, Sliding Gates, Tilting Counterweighted Gates; Rolling Dams or Barriers, Siphon Spillways, U. S. Reclamation Service Siphons, European Practice and the Huntington Lake Siphon Spillway. The Bulletin assembles, as fully as practicable, all the best information available in such a way as to be of use to anyone interested in the subject. Only the author's conclusions are here presented.)

It is the intention of the writer to point out, in as brief a manner as he can, the advantages of the siphon spillway when it is desired to facilitate the escape of high flood crests, and at the same time to conserve crest length, and cost of construction and maintenance, by eliminating the use of mechanical or other energy necessary to operate partially or completely automatic spillways of other types.

It is not too broad a statement to say that the siphon is the only absolutely "foolproof" method of maintaining adequate spillway capacity without the addition of moving parts to be constantly cared for and frequently replaced, and which very often fail to operate automatically or because of the absence of an intended operator.

Furthermore, the siphon permits of (1) closer regulation of the pond level, (2) the heightening of the spillway crest and therefore additional storage capacity where each unit of height is of greater value, (3) the coming into full and efficient action almost at the moment the danger point is reached, instead of having to depend upon additional danger-producing head to increase discharge, and (4) maintaining the desired pond level by quickly ceasing to act when the danger is passed.

It is evident that having provided adequate spillway of the siphonic type in about one-half the area required for any other known automatic type, the escaping water is concentrated to a narrow jet. This allows a more economical arrangement of the channel intended to neutralize the accelerated flow and convey it to a natural drainage course.

The writer has never heard any question raised as to the possibility of damage to land or structures below the point of installation of a siphon spillway, but it has occurred to him that such possibilities do exist and that provisions may be considered to counteract such damage. The spillway of a reservoir may be called upon to discharge a large volume of water.

In cases where ordinary overflow spillways are operating, the water released and allowed to continue down the watercourse would increase and decrease with the head on the overflow, and would at no time during the discharge be greater than the volume of water contributed to the reservoir above the structure. The watercourse under such conditions would be performing its natural functions.

In the case of an ordinary siphon spillway, from the instant the siphon comes into action the volume in the channel below the structure becomes the full spillway capacity and the burden of conveying this suddenly imposed surplus may be compared to that of a similarly released flood; this for the reason that the spillway capacity is usually assumed to care for both normal and flood flow into the reservoir.

A battery of siphons may be regulated so as to bring each unit into action separately or in pairs by placing their crests and air intakes at different elevations. The regulating parts are usually placed near the high-water line of the reservoir, where flow into it results in a slow-rising water surface.

Varying the elevation of the priming parts of the different units need not utilize a range of more than from 1 to 2 ft. in height, while it would regulate the outflow to conform more closely to the conditions of an ordinary overflow spillway and the volume released to the watercourses below the dam would vary with the reservoir inflow.

The lower unit should be fixed to operate at the level where it is desired to maintain the reservoir surface, and the remaining units should have their crests and air intakes set to operate at slightly higher elevations—still maintaining a safe freeboard above the highest air vent.

The writer is of the opinion that this practice has been followed on several of the larger installations, but for the purpose of regulating the pond level and not to govern the discharge to the stream below.

There are conditions where the siphon spillway is not adapted to the site or to the requirements which it is intended to serve, and its failure to perform under the improper conditions has led to condemnation of the structure as a type. For instance, one case cited in a criticism to the writer, refers to the tendency of a siphon to check the velocity of the stream near its intake and encourage the deposit of silt in front of the structure, where it was used as a regulator at the end of a canal. The design of this siphon did not take into consideration its utilization as a scouring device, but was intended only to skim the surface water and prevent the overflow of the banks of the canal. Some provisions should have been made temporarily to take care of the silt problem, since it was intended, as an ultimate development, that a power plant would be located near the site of the siphon and its installation was never intended for other than regulatory purposes. It may be stated that any other non-automatic method of control would have presented the same objections found in this case.

Another case where the siphon was condemned as a failure proved to be its attempted use as a series of "drops" on a canal system, and the principal objection in this instance was its failure to deposit the water from the upper to the lower channel in a vertical rather than a horizontal direction, necessitating more protection to prevent scour below the structure.

It is agreed that the use of a siphon as a substitute for the ordinary overpour drop would conserve area and in addition would deliver vastly more water to the lower level per unit of cross section, but it would also produce a velocity at the outlet so much greater than the velocity developed over an overpour drop that some method of destroying the energy of the rapidly falling water must be provided. It is not evident, however, why the water should not emerge from the siphon in vertical direction as it does in an ordinary drop. It is the opinion of the writer that the use of the siphon as a drop is another case of applying the principle to a foreign use without taking the necessary precautions to provide for its primary factor—accelerated velocity.

It is hoped that in the near future the more complete study of the structure as a standard design for different forms, conditions, and efficiencies will develop data to permit of its extended use.

TRANSMITTING ELECTRIC CURRENT TO SMALL KANSAS TOWNS

By F. H. Frauens, Jr., of W. B. Rollins & Co., Consulting Engineers, 208 Railway Exchange Bldg., Kansas City, Mo.

The use of transmission lines to supply electric current to small towns is increasing rapidly in all parts of Kansas, especially noticeable being the growth of municipally owned lines. For a number of years private concerns have been constructing high tension lines from large central stations and they have, in some sections, built up quite a net-work.

Of special interest, however, is the fact that many towns which have been operating small plants of their own, or have been without electric service, are beginning to see the advantage of high tension lines for reliability and flexibility of service.

When a reliable source of current is located within a reasonable distance and an equitable rate can be obtained, small communities can obtain 24-hour service and ample capacity for growing needs at rates less than the cost per kilowatt of operating a small plant, at the same time helping the plant from which energy is obtained reduce the unit cost of current by cutting down overhead expenses.

Small communities of even down to 100 or 200 population are demanding the comforts and convenience offered by electric current, and, while a few towns in isolated regions are installing storage battery plants of limited capacity, the tendency is to build for the future by constructing transmission lines to some neighboring plant where current can be obtained. We know of at least 35 towns where transmission lines have been built during the last year and several more where such lines are being planned. The time will come, of course, when some towns now operating a plant and supplying a number of smaller towns will themselves be supplied from a larger source, the lines now in use going to make up some of the many branches of a large net-work of lines.

Another advantage of the cross country line is the service that is furnished farmers, as electric current is doing a large share in the way of making life on the farm, both as regards fireside life and "doing the chores," more attractive. The determining factor in locating the route of a proposed line is often the location of the farms desiring to use the service to be provided.

Municipal Lines

As a general thing, municipal lines are fairly well constructed, and typical specifications for a line to supply a town of, say 500 population, would call for a 3-phase line of No. 6 copper wire or aluminum cable, on 6 in. x 30 ft. cedar poles, spaced from 26 to 35 poles per mile. Where the distance is not over 10 or 12 miles, a voltage of 6,600 is used, in many cases, however, the wire spacing and insulation being so as to provide for the use of higher voltages later on.

The rate charged for current depends of course on the size and type of plant supplying the current and varies, in the case of the majority of lines which this discussion covers, from 3 to 6c per kw., depending, however, upon the demand load. In one case, where current is obtained from a small municipal oil engine plant, the rate varies with the price of fuel oil, which is a neighborly method of doing business. As the loss in transmission and distribution is not over 25%, and usually less than this, current can be retailed at 10 to 15c, which allows interest on bonds and sinking fund to be paid.

The use of the out-door type of sub-station and equipment to make the operation of the consuming end of the line practically automatic cuts down both the first cost and the operating expenses. Switches operated by clock mechanism turn the street lights and white way systems on and off, so that outside of fuse burnouts and other accidents, the operation of the system is merely a matter of reading the meters and collecting the bills. There is very little upkeep, except tree-trimming, for the first 15 or 20 years, so that the services of some one to look over the line at intervals and to repair breakdowns due to storms, etc., is about all that is required.

Influence on Water Works Installations

A reliable and economical system of furnishing current for light and power also has a tendency to promote the installation of water works systems in small towns. Pumping by electricity is an attractive method, and, where the town is not burdened with a light plant that is a losing proposition, the citizens can usually see their way clear to own and operate a water works system.

One thing which has retarded the growth of transmission lines, especially as regards several towns of about the same size, has been town rivalry, or jealousy. Some towns were unwilling to build a line to a neighbor, beincreased by removing 5/8 in. rivets one at a time, reamcause they thought that by so doing they were helping out a rival instead of developing home industry. We know of one instance where a town refused for some time to consider getting current from a neighbor for just this reason. The citizens would tell you emphatically that they certainly would not help support a light plant located anywhere but in their own town. Now, however, after a line has been built and in service for some time, the same boasting citizens will chuckle and say, "Good joke on our neighbor; why, we have them working for us over there 24 hours per day."

SOME FEATURES OF SMOKE REGULATION IN PITTSBURGH

By H. B. Meller, Chief of the Bureau of Smoke Regulation, Room 608 City-County Bldg., Pittsburgh, Pa.

Smoke is a product of incomplete combustion, and the fuel used under smoking stacks is usually bituminous coal.

When fresh fuel is thrown on a fire, the volatile matter, consisting mainly of compounds of carbon and hydrogen, is driven off. Any part of these gases which is at red heat or above before being mixed with a sufficient quantity of air, will give off particles of carbon. Should these particles of carbon be below their ignition temperature before they are brought into contact with oxygen, they will show while in the gases as smoke and as soot where deposited on a solid surface. In the absence of sufficient air, some of these particles will unite with the hydrogen in the gases to form marsh gas, whereas with the proper amount of oxygen, the hydrogen will unite with it to form

water vapor, while the carbon unites with oxygen to form CO2. Therefore, with sufficient supply of air a part of the gases will be completely burned to CO2 which gives 14,600 heat units per pound of carbon and part will be burned only to CO which gives but 4,500 heat units per pound of carbon, and part will go out as smoke, the solid particles being uncombined. Air which is too cold will chill the gases and part of them will pass off unburned.

The fixed carbon in the fuel unites with oxygen to form CO2 or CO as the case may be. The residue in the fire box if we assume complete combustion is ash.

The problem is to get the proper quantity of air into the furnace at the right time and have it mix properly with the gases as they are driven off. A big factor of course is uniform feeding of coal and air, as with mechanical devices such as stokers.

This will indicate the importance from an economical stand-point of securing as nearly complete combustion as possible; and it goes further back—either less coal would have to be mined and transported or the shortage at a given time would be less acute. All of which would help the industrial situation.

After the smoke gets into the atmosphere, it must be reckoned with mainly as soot. The soot fall in Pittsburgh for the period of April, 1912 to April, 1913, was calculated to average 1,031 tons per square mile. One need not be told what damage is done to buildings and contents by such precipitation.

Fogs and Clouds

The gases of the atmosphere hold in suspension considerable quantities of condensed water vapor which forms fogs and clouds, and solid particles including dust and soot and other residues of combustion. The formation of fog is hastened in a smoky atmosphere and such a fog, instead of being white, may be gray or brown or almost black and so dense as nearly to exclude sunlight. Such a fog is heavy and settles to the lower levels and its evaporation is slow, both because of the retarding effect of the tar-covered particles and the slowness with which the heat rays from the sun are able to penetrate and dissipate it. The greater the quantity of smoke, the more persistent are the fogs and the fewer the hours of sunshine. What sunshine there may be is less intense. Daylight is depleted. These effects depend of course upon the size of the city, the amount of smoke, the topography and the wind velocities.

In Pittsburgh, for example, which lies mostly in valleys and is surrounded by hills, and with low wind velocities, the fogs settle readily. A considerable part of the density of these fogs is caused by smoke which is driven in from territory contiguous to the city over which the Bureau of Smoke Regulation has no control.

Effects of Smoke on Health

I am indebted to Dr. R. G. Burns, Superintendent of the Bureau of Infectious Diseases of the Department of Public Health, City of Pittsburgh, for the following statement as to the direct effects on health of breathing a smoke-laden atmosphere:

> The general effects of a smoky atmosphere upon the health of the inhabitants of cities have been broadly summarized by Wainwright who states that smoke interferes with the welfare of a community.
>
> 1st. By conducing to the formation of fog and rain.
>
> 2nd. By shutting out sunlight, depriving us of certain qualities of light of great importance in regard to changes in organic matter.
>
> 3rd. By depositing soot, rendering houses and their contents dirty.

He states that the acid content of smoke and the irritating particles suspended in it are harmful to the membranes of the air passages whether these be in a healthy or other condition; that it adds to the discomfort of those suffering from heart disease, lowers the tone of the general health, is a peril to the aged, diminishes buoyancy of spirit as well as reducing resistance to disease.

That a smoky atmosphere predisposes toward fogs is a fact long known. Statistics show a sharp rise in the death rate following a fog period; especially is this true in respiratory diseases, according to Rollo Russdell, who states that while cold is doubtless a factor in raising the mortality during a fog period, the most potent cause lies in the smoke constituents of the foggy atmosphere. He states that great cold combined with fog in the country is not productive of much illness whereas in smoky towns it is different. In London, the death rate was raised in a fortnight from 27.1 to 48.1 per thousand; that the prevalence and fatality of acute respiratory diseases were enormously increased and that the excess deaths totaled 2,994, and that at least 30,000 persons must have been ill from the combined effects of smoky fog and cold.

Authorities differ, some claiming a low temperature as the exciting cause, while others maintain that the mortality increase is due to the fog per se. Be that as it may, certain it is that the death rate from acute respiratory diseases increases.

Sohr and Rubuer believe that smoke predisposes to acute pulmonary tuberculosis. With this statement I am not prepared to agree, a compilation of deaths from pulmonary tuberculosis during the last decade in the ten largest cities of the U. S. shows the Pittsburgh rate of 105.6 to be the lowest and this in contrast with cities that are comparatively smoke-free.

Dr. White in his analytical study of the relation of smoke to pneumonia and tuberculosis in Pittsburgh where he states it is possible by virtue of its contours to separate the atmosphere into densly laden, moderately laden and comparatively no smoke areas, is forced to the conclusion that the smoke content of the air has an apparently important bearing on the pneumonia death rate and but little bearing upon the tuberculosis death rate. He further concludes that the death rate in the city of Pittsburgh is low, and that there is nothing in the smoke content of the air which in any way stimulates the onset of the tuberculosis process or militates against recovery from this disease when once contracted.

To sum up—if smoke is injurious to health then smoke plus fog is worse. That it irritates the air passages, predisposing to common colds, influenza, lobar pneumonia, acute bronchitis and the pneumonias incidental to measles and whooping cough, is beyond question.

If smoke were not injurious to health certainly the economic loss entailed would justify any and every

effort put forth for the prevention of such an obvious nuisance.

So far as the mental state is concerned, bright, sunshiny days undoubtedly have a tonic effect, while dark, foggy, smoky days are correspondingly depressing. It will be found that labor is less efficient on cloudy or smoky days.

Cost of the Smoke Nuisance

Now a word as to the cost in money of the smoke nuisance. John O'Connor, Jr., in an investigation conducted in Pittsburgh in 1913, reported that estimates of the annual loss per capita in Pittsburgh and other cities where the problem had been studied varied from $12 to $20. Mr. O'Connor tabulated his findings for Pittsburgh as follows:

1.	Cost to the smoke maker	
	(a) Imperfect combustion	$1,520,740
2.	Cost to the individual	
	(a) Laundry bills	1,500,000
	(b) Dry cleaning bills	750,000
3.	Cost to the household	
	(a) Exterior painting	330,000
	(b) Sheet metal work	1,008,000
	(c) Cleaning and renewing wall paper	550,000
	(d) Ditto lace curtains	360,000
	(e) Artificial lighting	84,000
4.	Cost to wholesale and retail stores	
	(a) Merchandise	1,650,000
	(b) Extra precautions	450,000
	(c) Cleaning	750,000
	(d) Artificial lighting	650,000
	(e) Department stores	175,000
5.	Cost to quasi-public buildings	
	(a) Office buildings	90,000
	(b) Hotels	22,000
	(c) Hospitals	55,000
	Total	$9,944,740

This brings us to Pittsburgh's experience in smoke abatement.

Experience of Pittsburgh in Smoke Abatement

Official cognizance of the smoke nuisance was taken as early as 1804. On June 10th of that year, the Burgess of Pittsburgh addressed a letter to the President of Council, uring that measures be adopted to remedy the nuisance. However, no legal regulation was attempted until shortly before 1869 when action was taken that "no bituminous coal or wood shall be used in the engine of any locomotive employed in conducting trains upon any railroad."

The discovery of natural gas and its utilization as a fuel practically freed the city for a time from smoke. In 1881, William Metcalf, an engineer and mill owner, estimated the cost of the smoke nuisance to be more than one million dollars a year. In 1884, Pittsburgh was using annually about three million tons of bituminous coal. With the introduction of natural gas this fell off to less than one million tons, but by 1890 the coal consumption again began to move upward and by 1895 smoke was again the great nuisance.

In March, 1892, the first general ordinance was passed making it unlawful for any chimney or smoke stack used in connection with a stationary boiler to allow, suffer or permit smoke from bituminous coal to be emitted or escape therefrom within a certain district.

A second ordinance was passed in May 1895, providing that the emission of more than 20% black or dark gray smoke from any stack should be considered a public nuisance. A decision of the Superior Court virtually made this ordinance inoperative.

Another ordinance was passed in December 1906 declaring the emission of dense black or dense gray smoke for more than 8 minutes in any one hour to be a nuisance and prescribing penalties for violation.

On March 3rd, 1911, this ordinance was declared void on the grounds that the legislature of Pennsylvania had likely not given the city any sufficient authority to pass ordinances on the subject of the emission of smoke and that the ordinance was unreasonable.

On June 6th, 1911, the Legislature passed an act authorizing cities of the second class to regulate the emission of smoke and in September, 1911, a new ordinance, the present one with one modification—that of the exception of mill heating furnaces and puddling furnaces—was passed. The present ordinance superseding this was approved Jan. 4, 1917, and provides that "No person or corporation shall construct, install, reconstruct, alter or repair any furnace, boiler-furnace, stack or other apparatus connected with stack, unless he or it shall make application in writing to the Bureau of Smoke Regulation on the form furnished by the said bureau, duly sworn to before a notary public, or any person authorized to administer oaths, for a permit for such construction, installation, reconstruction, alteration or repair and in and by such application shall give the plans and specifications, showing the style and dimensions of the furnace, boiler-furnace, stack or other apparatus connected with a stack intended to be used, a description of the building or part thereof in which such furnace, boiler-furnace, or other apparatus is located, including the means provided for regulating the temperature of such building or part thereof and ventilating the same, and generally all provisions made for preventing smoke together with a statement of the kind of fuel proposed to be used and of the operating requirements to be made of the furnace or furnaces referred to therein and unless such application shall be passed upon by the Bureau of Smoke Regulation, and approved in writing and a permit issued as hereinafter provided; provided, however, that minor or emergency repairs which do not increase the capacity of such furnace, or which do not involve any substantial alteration in such furnace, boiler-furnace, stack or other apparatus and which do not involve any alteration in the method or efficiency of smoke prevention, may be made without a permit."

Policy of Cooperation

Throughout the policy has been one of cooperation, and meetings of operators were called from time to time. The responses in general were prompt and sincere, the percentage of those who had to be forced into compliance being very small.

The keynote always has been the saving to be effected by securing higher efficiency from the plant. The following extracts from letters show that this was more than justified. Many of the men who at the beginning were active opponents or were at least apathetic became warm supporters when they found compliance, unwilling perhaps at first, saved them money.

Handling of Typical Cases

It may be of interest to know how typical cases would be handled by the Bureau:

(1) The Case of a Violator: The inspector will report a violation of the ordinance, which means that the density of the smoke issuing from the stack was No. 3 or greater for at least 2 minutes in a period of 15. If he is near enough to at once go into the plant, he will ascertain the cause of the violation and if possible correct it at the time stating that fact in his report. If he does not enter the plant, a letter is sent reading about as follows:

Notice of Violation of Ordinance No. 566.

This is the first notice of violation of Ordinance No. 566 for the current month and the —— notice for the current year.

It is not the policy of this Bureau to avail itself of the penalty section of Ordinance No. 566 where an immediate effort is made by violators to eliminate the cause for violation.

Information is desired, therefore, as to the cause of violation now reported to you and a statement as to whether such violation may be expected to recur.

If there is any information or advice which can be given by this Bureau or if the assistance of any of its inspectors will aid you, the Bureau will be very glad to avail itself of the opportunity to cooperate.

If remedial action is not taken and a second violation is reported, an inspector is detailed to make a report on conditions. Recommendations are prepared and the operating head of the concern is asked to call at the Bureau of Smoke Regulation where he is told what our recommendations are and asked to cooperate to eliminate the smoke. This, in nearly all cases, brings the desired result, although occasionally considerable prodding is necessary. If as has occurred, correction is not made by the operator, suit may be entered. This is a last resort and its application has been required in a limited number of cases. Sometimes it is necessary to give an operator considerable time to make the necessary changes and during such period violations must be more or less ignored, provided he is doing the best he can with the equipment he has. All cases of complaints received from residents are investigated in a similar way

(2) Alterations and Repairs: In such cases, permits are required before the work can be done. These are handled as prescribed by the ordinance—investigation of conditions being made by the inspector, drawings submitted, examined, corrections made if necessary and the permit issued or refused.

(3) New Installations: These are handled as prescribed by the ordinance, plans being required to be submitted. Recently we have secured the cooperation of the Bureau of Building Inspection. When an application for permit for a building is received by that Bureau, it must be approved so far as the fuel-burning apparatus is concerned by the Bureau of Smoke Regulation before building permit is issued.

The personnel of the Bureau is a Bureau Chief, four inspectors and two stenographer-clerks. At the present time, one inspector spends all of his time on direct observations of stacks; one spends all of his time on the inspection of locomotives, steamboats, steam shovels and portable hoists; one spends part of his time investigating complaints and the remaining part on direct observations. The fourth is on special work which consists largely of examinations of conditions where alterations or repairs are necessary and where new equipment is to be installed.

I have sketched very briefly a few points in the smoke problem. Summed up, it means where there is a smoke nuisance, it represents a direct economic loss. It is also a loss by reason of the poorer health, poorer living conditions and poorer spirits of the inhabitants; and such a place is less beautiful and less desirable for a home than it would otherwise be.

Can the smoke nuisance be eliminated? Yes. Easily? No. It means a constant fight, but the results are well worth all the effort ever put into it.

The foregoing paper by Mr. Meller was presented at the annual meeting of the League of Cities of the Third Class in Pennsylvania, held at York, Pa., on Aug. 25, 1920.

SOME MUNICIPAL IMPROVEMENT POLICIES OF ALBANY, NEW YORK

By Frank R. Lanagan, City Engineer, City Hall, Albany, N. Y.

Certain policies of the Bureau of Engineering of Albany, N. Y., effective in the last few years, had a good influence in guiding the many public improvements along proper channels.

Every Pavement Must Have Concrete Foundation

One policy which created friction at first but now cheerfully submitted to is that no street will be paved, even though the entire cost is paid for through assessment on the property benefited, except it has a concrete foundation. Under modern traffic conditions in a city, it is not economical to put down macadam, or asphalt—or tar-bound macadam, even though the street is a residential one, ordinarily subject to light traffic. There is nothing to prevent a five, eight or ten-ton coal or stone motor truck, or a heavy motor bus or ice wagon, or a team drawing heavy girders, from using such a street. One unduly heavily loaded vehicle in a single passage in the spring when the frost is coming out of the ground can and does do material damage to the carriageway by ruts or breaking through the surfacing and the annual cost for maintenance and repairs due to even this occasional heavy traffic makes this type of roadway on a city street more expensive than more permanent construction, higher in initial cost. Real estate speculators developing new streets as a general rule prefer and urge the cheapest kind of improvements because their greatest concern is to sell the lots, but it is better to stand adamant to their pleadings than to stand the reproaches of many property owners in three or five years time when one of the cheap improvements goes to pieces. Normally a city is a growing proposition and values are great enough to warrant more permanent improvements.

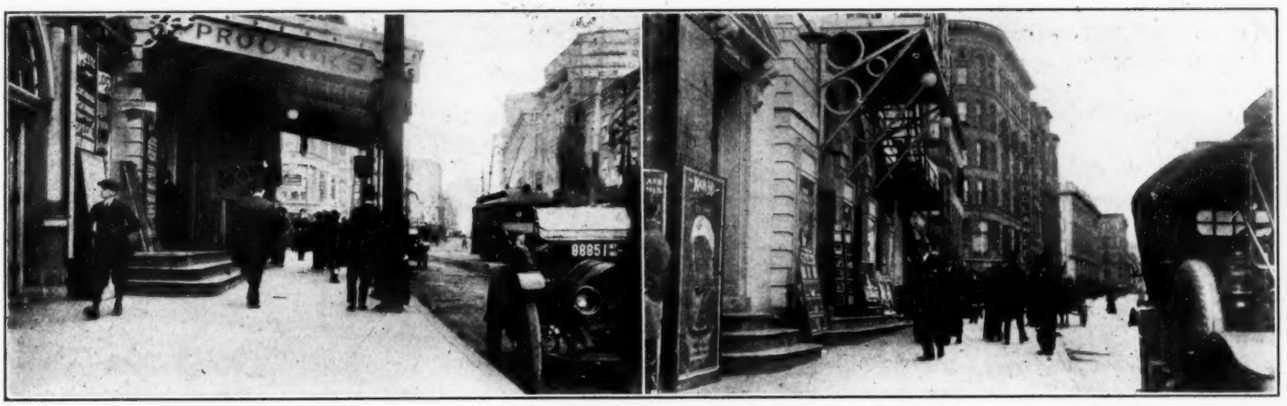
Effect of Public Improvements on Private Property

As a general rule, it is safe to assert that street improvements of a permanent character increase the value of real estate by more than the cost of the improvement assessed against the property in question. Improvements have been authorized on certain streets in poor localities where it has seemed as though the property could ill-afford to stand the assessment and yet after the completion of many of these improvements, owners have painted their houses, repaired their steps and stoops and spruced up generally. Windows which have not been so blessed for years get washed inside and out and clean curtains appear as by magic. Thus, more often than not, the tidiness of the roadway and walks is contagious. The whole improved condition of the street and bouses, favorably affects property values of the neighborhood. In business districts where obsolete pavements have been replaced with new wires placed in underground conduits, poles

and sidewalk encroachments removed and uniform sidewalks of concrete laid, extensive alterations and betterments to places of business have followed as a matter of course and in many cases, it has paid owners to construct new buildings because the generally improved condition has attracted trade.

Tree Planting

Another policy which has won some initial commendation and will merit more in the future, is the policy of planting trees on new residential streets in connection with the work of grading, paving, curbing and laying walks. There are a certain few varieties of shade trees that do well in the climate and soil of Albany and the choice of variety is restricted to these few. When the planting is done in connection with the improvement of the street, the work is done in co-operation of the Bureau of Parks with the Bureau of Engineering. The actual cost of the trees and planting is assessed against the property in connection with the other costs of the improvement to be assessed. As a general thing, one variety only is planted on a street. On some wide streets where there are grass plots in the center of the roadway, a different variety is planted in the center from what is planted on the walks. Sometimes, when conditions warrant, flowering shrubs of various kinds are planted in the grass plots. Where trees are planted near enough to the curbs to be within reach of horses, wire guards are used. With the growing use of motor vehicles in the city, there is not now the same need for wire guards as formerly but even so they continue to be of use if only to protect the bark from the small boy with a new jack-knife.



VIEWS TAKEN BEFORE AND AFTER REMOVAL OF SIDEWALK ENCROACHMENTS IN ALBANY, N. Y.

Controlling Street Layouts on Private Real Estate Developments

The policy of assuming control over new street layouts on private real estate developments became and is necessary to protect the city from inferior layouts, layouts which violate well-known principles of city planning.

In the year before the war when real estate was booming, so many developments were being put on the market with inferior street layouts that the city administration had to take action to protect the city and uninformed purchasers of lots. It is now necessary to have all plans for new streets approved by the City Engineer before a plan for a new development will be received by the County Clerk for filing. Approval by the City Engineer is also a guarantee of the future acceptance of deeds of the streets by the city for public streets. The city does not undertake to provide public facilities and conveniences such as sewers, water, sidewalks, curbs, pavements, lighting, etc., on private streets.

The approval of new street layouts in private developments is a difficult duty because a street layout that will cut a piece of property into the greatest number of lots and to the advantage of the owner may be just the layout which is unsuitable for the land, necessitating big cuts and fills in future grading, difficult to drain and connect into the sewerage system of the city. If the owner is made to change his plans to better meet these and other conditions and loses three, four or five lots from his plan in consequence, then he feels he has been badly treated by an unpracticable, visionary and unreasonable person.

The main difficulty with the present method of laying out new streets is that they are planned piece-meal, that is they are planned within the limits of a farm or single piece of property, without reference or thought as to how these streets will connect with future developments of adjacent properties or co-ordinate with the established system of city streets.

The proper way to plan new streets in undeveloped sections of the city is to consider the section as a whole, disregarding property lines of vacant land, making the street lines conform, so far as practicable and consistent with good planning, to the topography, varying the street widths to accommodate probable future traffic and connecting the new system in a proper manner to the established street plan of the city. The difficulty in making such a street plan effective as development takes place is the attitude of individual owners or real estate speculators who object to following a plan which does not cut their property to their best advantage. It is generally possible to convince such owners that values will be greater per lot with a good and proper street plan than with one which disregards adjacent properties and the established street system of the city. Publicity and public education by means of illustrated newspaper articles and by lantern slide lectures before improvement associations or similar societies will generally marshal public opinion in favor of the official plan and thus have a tendency to prevent a selfish interest from desiring to perpetuate an unwise development on the city.

THE LARGEST ASPHALT REFINERY IN THE WORLD

Pittsburgh and steel, Akron and rubber, Bridgeport and brass, East Liverpool and pottery, Texas and petroleum. Each pair is a mental link in one's chain of thought when either the locality or the industry is mentioned. It is singular to note, however, that every one of the industries mentioned has lent fame to a city, with the exception of the petroleum industry, and the entire State of Texas is associated inextricably with petroleum instead of a single city or town.

The town of Beaumont in Texas gained extensive prominence when the famous Spindle Top field was discovered, and the town of Burkburnett has become noted through the petroleum fields there. Neither of these two places, however, is so widely known as to be called the Pittsburgh of the petroleum industry. Yet there are petroleum refineries in Texas which are the largest of their kind in the world and any one of them would make a city famous. These plants are spread over a large area, however, and therefore no one place gets the advantage of the prominence which would sprout from their concentration.

So enormously has the petroleum industry grown in Texas that there are stupendous plants there devoted exclusively to the manufacture of single petroleum products. An example of this is the largest asphalt refinery in the world operated by The Texas Company at Port Neches, Texas. It extends ¾ of a mile along the Neches River and 2½ miles back into the country, and has become world-famed among persons interested in road building and other uses of asphalt. Were this plant in another locality, say as central as Pittsburgh or Akron, it would bring fame to the city or town near which it was situated. As it is, however, the town of Port Neches and the mammoth asphalt refinery there are noted mostly among the world-wide users of asphalt products, and are not famous generally among laymen of all descriptions as Pittsburgh and its steel mills are.

Fame is Growing

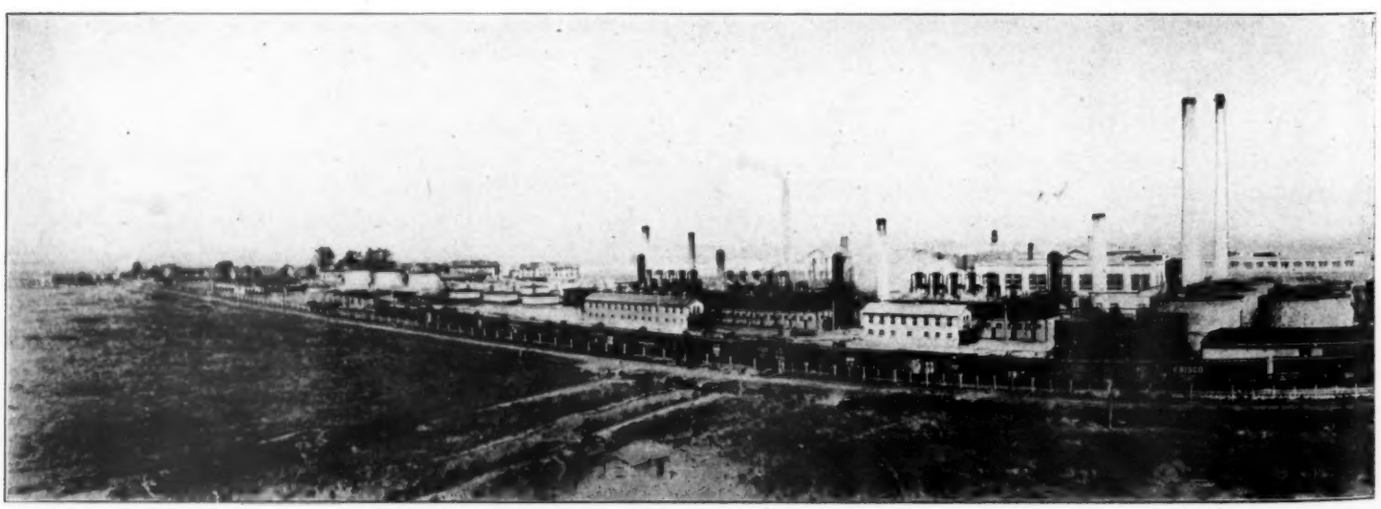
Destiny, however, seems bent on spreading a broader mantle of prominence over this largest of the world's asphalt refineries. It is coming about in this way. The people in every state in the country are realizing the vital demand being made through the growth of the automobile and motor truck industry. This greatest demand is

SCENE IN ASPHALT LABORATORY AT THE PORT NECHES REFINERY OF THE TEXAS COMPANY SHOWING, IN FOREGROUND, MACHINE TO MEASURE DUCTILITY OF ASPHALT.

for *Good Roads*, as the 7,143,954 automobiles and 421,692 motor trucks that are being operated in this country must have improved highways to ride over. It is an economic necessity!

So, in view of these facts, the layman as well as the engineer and the road builder is taking an interest in improved highways. He wants to know how the money is spent on the new highways, how the roads are built, what materials are used and where they come from; hence, wide public attention to the Port Neches asphalt refinery is increasing steadily.

As one enters the asphalt refinery he immediately is impressed by two things: first, the immensity of the place, and second, the quietness of it. His vision is overtaxed by the mammoth size of the plant, and his curiosity is aroused because there seems to be so little noise. Sure-



Executive Offices Storage Tanks Storage Tanks Stills

BIRD'S-EYE VIEW OF THE PORT NECHES REFINERY OF T HE TEXAS COMPANY, LOCATED AT

ly there are not hundreds of persons employed here! One sees only a few men briskly walking about performing their duties! Yet, in reality, there are scores and

EXPERT OPERATOR OF THE TEXAS COMPANY DETERMINING THE FLASH POINT OF A SAMPLE OF ASPHALT IN LABORATORY OF THE PORT NECHES REFINERY.

scores of men working with trained eye, mind and hand in turning out the asphalt products which will later form a large part of the country's lasting highways.

In the first glance over the refinery one sees the company's large docks and waterfront;—in back of these is the civic center, where are located the offices, dormitories, commissary, club house, and cottages for the employes. Next the eye will note immense storage tanks, then lengthy rows of stills, storage sheds, locomotives, and railroad tracks, and numerous other buildings and structures. A description of the entire refinery, however, may be given by following the asphalt through the process of production.

Process of Production

The crude asphaltic base petroleum from the oil fields is transported to the refinery through pipe lines and in large tank ships; upon arrival at the refinery it is pumped into storage tanks. From the storage tanks the material is pumped into the stills, of which there are 70 at the Port Neches plant. These stills are dull and insignificant in appearance despite the all-important part they perform in the production of the asphalt;—they don't even look as if they were hot. They look like enormous boilers set in brick and are strikingly similar to the average steam boiler, only much larger. The brick walls cover two-thirds of the stills, which look from the front like ordinary furnaces with doors and pipes, gauges and other devices. As oil is used for fuel, there is little to be seen other than the oil pipes which spit forth their fluid into the white-hot fires.

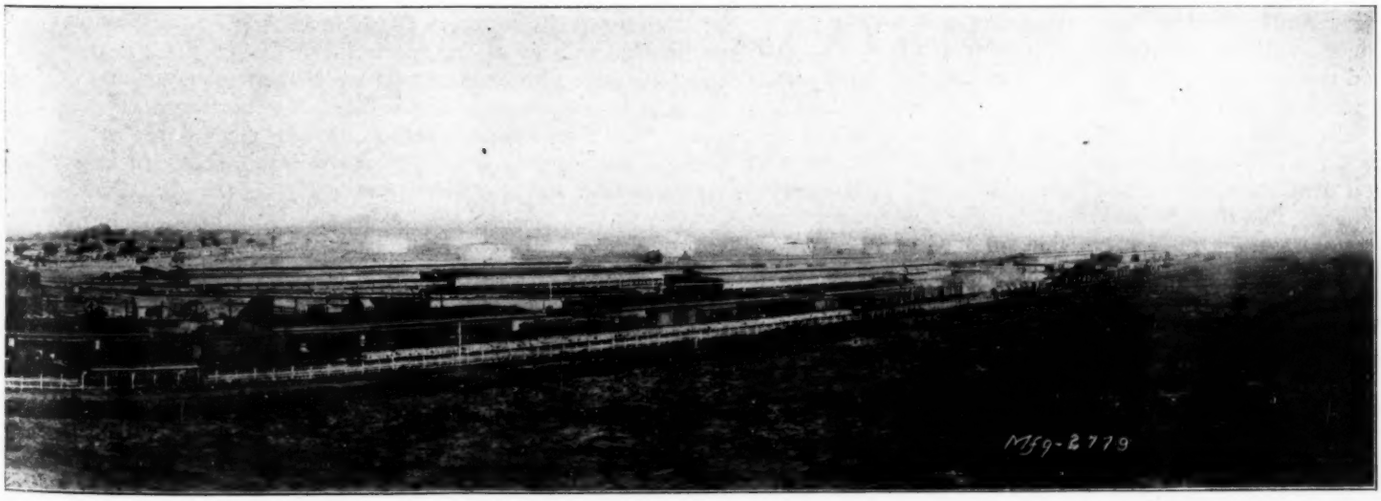
About all one can see of the process of making asphalt is the gauges which denote the maintenance of temperature at certain specified degrees, the addition of crude material from time to time and the removal of the finished product from the stills. The stills are in two rows with the furnace ends facing a street about 100 ft. wide. This passage way is as clean and devoid of excitement as the average walk on a country estate. Now and then a man in overalls comes to the scene, passes along the front of the stills looking at the gauges, turns something somewhere and passes on leaving the street as deserted as it was before he made his visit.

As a producer of excitement the production of asphalt is a dismal failure. It is the most unexciting thing in the world considering the tremendous importance of the process. Workmen move about with deliberation and calmness and give a distinct impression that they know what they are doing and why they are doing it, but the uninitiated would never guess their thoughts!

When the crude asphaltic base petroleum is pumped into the stills it is maintained at specific temperatures for certain lengths of time. The lighter oils are removed during the process of distillation and are pumped to another refinery, leaving the thick, binding, adhesive asphaltic base. This process is continued until the asphalt reaches the proper consistency. From the stills the finished asphalt is pumped while hot into large storage tanks or directly into barrels or tank cars.

Testing the Asphalt During Refining

Food that passes over the tables of American homes is not examined and tested and fussed over one-tenth as

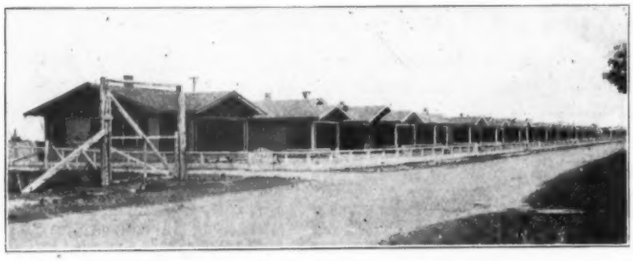


Box Cards Loaded with Asphalt in Barrels Barrels of Asphalt on Flat Cars Storage Sheds and Tank Fields
PORT NECHES, TEXAS. THIS IS THE LARGEST ASPHALT REFINERY IN THE WORLD.

much as the asphalt is during the process of refining. Pharmacists in mixing prescriptions are no more exacting and minute in their work than the chemists who test the asphalt which will later be mixed with other materials for the country's highways.

Each batch of asphalt goes through 50 different tests before it is turned out as a finished product. In the complete and modern laboratory of the refinery, a group of chemists perform these tests, each one making his test independently and then comparing the results with those of his associates.

Tests are made for penetration, ductility, flash point, solubility, specific gravity, etc. The penetration test records the hardness of the material, the ductility test shows its stretching power or cohesion, the flash point denotes at what temperature the product will catch fire, the solubility test indicates the purity of the product and its freedom from foreign substances, and the specific gravity test indicates the weight of the asphalt as compared with that of water.



ROW OF HOUSES BUILT FOR AND OCCUPIED BY EMPLOYEES AT THE PORT NECHES ASPHALT REFINERY OF THE TEXAS COMPANY AT PORT NECHES, TEXAS.

Perhaps the most interesting test is that made for ductility. A block of asphalt is placed in a trough of water maintained at a certain temperature. A motor is then started and stretches the asphalt until it breaks, the breaking point measured in length, usually centimeters, being the required information.

More than a score of standard grades of asphalt, road oils and binders are produced at the Port Neches plant of The Texas Company. This illustrates the care and precision necessary in the chemical and physical tests, as the various products range from the light road oils and binders to the harder materials for heavy highway traffic, and for the production of roofing, paints, and other commercial commodities.

The remainder of the refinery consists of storage sheds, a thoroughly modern plant where all the barrels and drums are made, machinery shops and maintenance depots. The storage sheds have a capacity of more than 500,000 barrels of asphalt, while the cooperage plant is one of the most complete in the country, and in itself comprises a large industry.

The transportation system of the refinery is equally complete. There are 15 miles of standard gauge railway inside and five locomotives are kept busy constantly moving the large shipments.

Housing and Social Life

Cottages, dormitories, a field for athletics, a club house and ball room, combined with many other conveniences, provide an enviable home and social life for the employes. Only a nominal charge is made for board and lodging, and the management prides itself on its efforts and success in providing amusement and pleasure for the refinery's employes.

TRANSPORTATION OF GARBAGE WITH DATA ON GARBAGE DISPOSAL IN VARIOUS CITIES

By Samuel A. Greeley, of Pearse, Greeley & Hansen, Hydraulic and Sanitary Engineers, 39 W. Adams St., Chicago, Ill.

(Editor's Note:—Mr. Greeley recently made a report to Mr. David H. Goodwillie, Director of Public Service, Toledo, Ohio, recording the results of the investigation of garbage collection and disposal in Toledo, the canvass of bids received, the investigation of various processes for garbage disposal proposed and used in other cities, together with the result of studies made of the data so secured. An award was made in July, 1920, to the Toledo Disposal Co. for disposal by reduction. Mr. Greeley's report contains much information of general interest, in addition to that pertaining directly to Toledo conditions, and from this general information the following data and discussions are here presented for the information of other engineers and officials.)

TABLE I—COST OF TRANSPORTING GARBAGE

City	Year	Method	Tons of garbage	Cost of trans. per ton
Chicago	1919	Barge	786	0.962
Baltimore	1920	Barge		.30
Detroit	1920	Railroad		.75
Washington, D. C.	1919	Railroad	53,258	.68
Cleveland	1918	Railroad	57,754	0.342
Pittsburgh, Pa.	1920	Railroad	60,000	.60
Columbus	1918	Railroad	15,630	0.203
Indianapolis	1919	Railroad	16,587	.26
Dayton	1919	Railroad	11,360	.55
Grand Rapids	1917	Railroad	10,500	0.45
Utica, N. Y.	1919	Tractor-Trucks	8,400	1.43
Wilkesbarre	1918	Truck	7,500	1.60

Transportation of Garbage

In most cities the garbage is delivered in the collection wagons by team haul to the place of disposal. In some of the larger cities, where the haul is long, it becomes economical to provide transportation in larger quantities than the collection wagons. There is then required one or more loading stations and vehicles for the transportation. The methods of transportation in general use at present are the following: Steam railroad, boat, truck, tractor-trailer and electric railroad.

a. *Loading Stations* are required to unload the collection wagons and to load the transportation vehicles. They

TABLE II—COLLECTION DATA FOR SEVERAL CITIES

City	Number of houses per collection per working day	Time in minutes per house—one man basis
Pittsburgh	275	
Washington	480	0.91
New Orleans	456	
Chicago		1.47
West New Brighton		0.91
Evanston	79	1.21
Lake Forest		10.00
Louisville		0.37
Milwaukee	89	2.32

TABLE III—APPROXIMATE NUMBER OF WAGONS FOR GARBAGE COLLECTION

City	Approximate population from which collections are made	Wagons: Number	Wagons: Capacity cu. yds.	Approximate interval between collection days	No. of trips per wagon per day	No. of men per wagon	Average No. of wagons per 100,000 population
1. Chicago	2,000,000		4.0	6	1	1	
2. Cleveland	790,000	105	2.5			1-2	13.3
3. Baltimore	700,000	200	2.5	2			28.6
4. Los Angeles	575,000	49	5.0	1-3	2.3	1	8.5
5. Buffalo	500,000	18	5.0	2	2	3	3.6
6. Milwaukee	450,000	100	1.5	6	2	1	22.2
7. Pittsburgh	450,000	50	4.75	6	2	2	11.1
8. Washington	430,000	90	2.2	2-3		1-2	20.9
9. Newark	300,000	14	4.0	2	3	2-3	4.7
10. Columbus	230,000	22	3.0	6	1	1	9.6
11. Worcester	120,000	19	2.5	3	1	1	15.8
12. Toledo							
Actual	240,000	28	3.0	6	1	1-2	11.7
Proposed		22	3.0-4.25	6	1-2	1-2	9.2

are of several different types. Some comprise an elevated platform, with inclined approaches, from which the wagons are dumped into freight cars, boats or other vehicles. The platform should preferably be attractively housed, be built with concrete floors and fitted with ample water supply and sewerage for washing. Other loading stations comprise a crane for picking up wagon bodies and emptying them into or placing them on the transportation vehicle. Loading stations are in operation at the following, among the 50 larger cities in the United States: New York, Chicago, Philadelphia, Detroit, Baltimore, St. Louis, Pittsburgh, Cleveland, Boston, Cincinnati, Minneapolis, New Orleans, Columbus, Grand Rapids, Dayton, Washington and Salt Lake City.

Many of the loading stations are quite critically located; some are well built and others rather poorly. New York, Chicago, Baltimore and Boston have water front loading stations and boat transportation. All of the others have railroad service. In Philadelphia, Detroit, Boston and Columbus, the loading stations are housed, but in many of the others the platforms are uncovered. Most of these loading stations have been in operation many years. Nevertheless, because they should be near built-up districts where the garbage is produced, it is always difficult to secure locations.

b. *Steam Railroad Transportation* is the most usual method. Amongst the 50 large cities, it is used by the following: Detroit, St. Louis, Pittsburgh, Cleveland, Cincinnati, Minneapolis, New Orleans, Columbus, Grand Rapids, Dayton, Salt Lake City and Washington.

Various kinds of cars are used. Cleveland and Columbus have specially built side dumping cars. Detroit and Minneapolis have flat cars on which the wagon bodies are stacked. In Pittsburgh the cars have high sides, re-

TABLE IV—APPROXIMATE DATA ON GARBAGE DISPOSAL BY FEEDING TO HOGS

City	Population 1920	Ave. tons garbage per day	Place of delivery to contractors	Method of haul to farm	Distance from farm to city limits—miles	Area of farm—acres	Average No. of hogs	Payment to city per ton
Baltimore	733,826		Farm	Boat	12	160	4,000	$0.52
St. Louis	733,000		Farm		15			0.25
Buffalo	505,875	60	Farm	Tractors	4	69		.50-.90
Newark	415,609	30	Farm	Team	0	8	4,500	1.20
Minneapolis	380,498		Tr. Sta.	Railroad	6	80	2,000	1.26
Portland	(308,319)		Tr. Sta.	Team	1			3.90
Denver	256,369	60	Houses	Team	½		10,000	
St. Paul	234,595			Team				1.95
Louisville	234,891		Tr. Sta.					3.50
Akron	208,435	47	Farm	Team-Trucks		200		1.00
Providence	(259,895)	100	Houses		7	1,000		
Worcester	(166,106)	30	Houses	Team	0	376	3,000	
Grand Rapids	137,634	36	Tr. Sta.	Railroad	43	240	6,000	0.25
Omaha	191,601	50	Farm	Team	0		5,000	.06
Salt Lake City	118,110	15	Tr. Sta.	Railroad	6	60	2,000	
Utica	94,136	25	Farm	Tractors	4	160	1,600	
Wilkesbarre	73,828							
Topeka	(49,538)	10	Houses	Team-Trucks	1	15	800	0.0
Madison	38,378	10	Farm	Team-Trucks	3			
Highland Park	46,599	15	Tr. Sta.	Team	4	40	600	0.45

Notes—1. Other cities feeding: Kansas City, Wheeling, Hartford, Cambridge, Kalamazoo, Jackson, Rockford, Harrisburg.

TABLE V—APPROXIMATE DATA ON HOG FARMS FOR GARBAGE DISPOSAL

City	Approx. population 1920	Tons of garbage per day May, 1920	Number of hogs: Capacity	Number of hogs: 1920 Total	Per ton garbage	Area of farm in acres	Total No. of men	Amount of hog manure: % garbage	Sq. ft. per hog: Pen	Sq. ft. per hog: Feeding platform
Baltimore	700,000	33	5,000	850	26	157	8-14	50	7.6	4.8
Newark	415,000	38	4,000	1,210	32	8	5	50	7.5	2.4
Buffalo	600,000	60	5,000	4,300	71	69	12	30	7.5	17.0
Highland Park	40,000	14	750	750	53	40		50 to 57		
Worcester	175,000	30	3,000	3,000	100	376	10	65	7.2	
Minneapolis	380,000	50	2,500	2,500	50					

TABLE VI—METHOD OF GARBAGE DISPOSAL IN THE 50 LARGEST CITIES OF THE UNITED STATES

As taken from Table 6—Bulletin 133, U. S. Census, 1916

Dumping	Incineration	Reduction	Hog feeding	Changed from reduction to hog feeding	Changed from hog feeding to reduction
New York	Milwaukee	Chicago	Buffalo	Buffalo	Los Angeles
New Orleans	Atlanta	Boston	Newark	Baltimore	
Seattle	Scranton	Pittsburgh	Baltimore	Akron	
San Francisco	Minneapolis	Detroit	Denver	St. Louis	
Oakland	Birmingham	Cincinnati	Worcester		
Jersey City	Richmond	Cleveland	St. Paul		
Dallas	Spokane	Columbus	Louisville		
	Memphis	Dayton	Portland		
	Paterson	Indianapolis	Akron		
	San Antonio	Los Angeles	Salt Lake City		
		Rochester	Providence		
		Toledo	Grand Rapids		
		Syracuse	Omaha		
		Philadelphia	St. Louis		
		Washington	New Haven		
		Bridgeport	Fall River		
		New Bedford			

sembling box cars with the roof off. Most of the others use gondola type freight cars.

c. *Boat Transportation* is used in New York, Chicago, Boston and Baltimore. In Chicago only a small amount of the garbage is transported on deck scows, the wagon bodies being stacked two deep. In the other three cities the garbage is dumped in bulk into barges.

d. *Truck or Tractor-Trailer Transportation* is a more recent development, being used in the following of the 50 larger cities: Trucks—Akron, Atlanta and Wilkesbarre; Tractor-Trailers—Buffalo, Indianapolis and Utica.

This method requires a high first cost with a correspondingly high interest and depreciation cost.

e. *Team Haul.* In by far the largest number of cities the garbage is delivered to the disposal plant direct by team haul as follows: Chicago, Los Angeles, Portland, Milwaukee, San Francisco, Toledo, Louisville, St. Paul, Providence, Denver, Seattle, Rochester, Jersey City, Oakland, Kansas City, Bridgeport, Birmingham, Scranton, New Haven, Worcester, Syracuse, Schenectady, San Antonio, Richmond, Omaha, Fall River, New Bedford, Paterson, Memphis and Spokane.

This general summary provides a perspective of practice in this country. In Chicago, Brooklyn and Philadelphia some mixed refuse has been transported by trolley cars. In Chicago this method has been abandoned because no dump accessible to trolley tracks is available.

In all cases cleanliness is an essential to successful operation, particularly as regards loading stations.

The accompanying tabular matter is of wide interest. Table I gives the method and cost of transporting a ton of garbage in various American cities. In Table II is given the average time in minutes required to collect the garbage from a house in 9 cities. Table III gives the approximate number of wagons for garbage collection used in 12 cities. Table IV gives a quantity of approximate data on garbage disposed by feeding to hogs in 20 cities, and Table V gives approximate data on the hog farms used for garbage disposal in 6 cities. Table VI gives the method of garbage disposal in the 50 largest cities of the United States.

SURFACE TREATMENT OF STONE AND GRAVEL MACADAM AND CONCRETE ROADS IN WISCONSIN

By J. T. Donaghey, Maintenance Engineer, Wisconsin Highway Commission, Madison, Wis.

(Editor's Note: The following instructions on the surface treatment of stone and gravel macadam and concrete roads in Wisconsin were recently issued for the guidance of patrolmen, in Bulletin No. 11 of the Wisconsin Highway Commission.)

Sweeping the Surface

Sweep the surface of the road with a power sweeper until all dust is entirely removed from the stone surface, and remove the accumulations of dirt and vegetable matter from along the edges of the stone surface with the light grader.

If there are any spots of vegetable matter remaining on the surface, remove them by the use of a hand broom or shovel.

Be sure to have the surface clean before starting your oiler for if there are any spots not thoroughly cleaned, the oil will not penetrate to the road metal, leaving a blanket of dirt between the oil and the stone which will eventually pit out, causing very disagreeable holes in the road surface.

Where a surface treated road has become wavy or uneven it is best to scarify it rather than to attempt to even it up in any other way. The scarifying should be done as early in the season as possible while the ground and stone underneath the surface is cold. At this time the old surface treatment will break up and can be harrowed with much less effort than later in the season when the weather and material are warm. After scarifying, the surface should be thoroughly harrowed with a heavy pegtooth harrow gone over with the blade grader a sufficient number of times to remove all waves and depressions that were formerly in the surface. The surface should now be gone over a few times with a road roller in order to compact the loosened material after which the surface treatment should be applied in the usual manner and an absorbent of torpedo sand or pea gravel or stone chips applied.

It is advisable at times to use stone as large as 1½ ins. in size, rolling the stone into the surface of the road after the bitumen has been applied. The larger stone practically nails down the surface to the old metal and keeps waves from forming in the future.

Distributor

Use a pressure distributor and have power enough before it to move along at a speed that will develop the necessary pressure to insure an even distribution of the oil. A motor truck supplies the best power for the majority of distributors, but good results may be obtained with four horses. A few counties have purchased motor oilers which are very satisfactory. Others have mounted a tank and distributor on a motor truck resulting in equally good work.

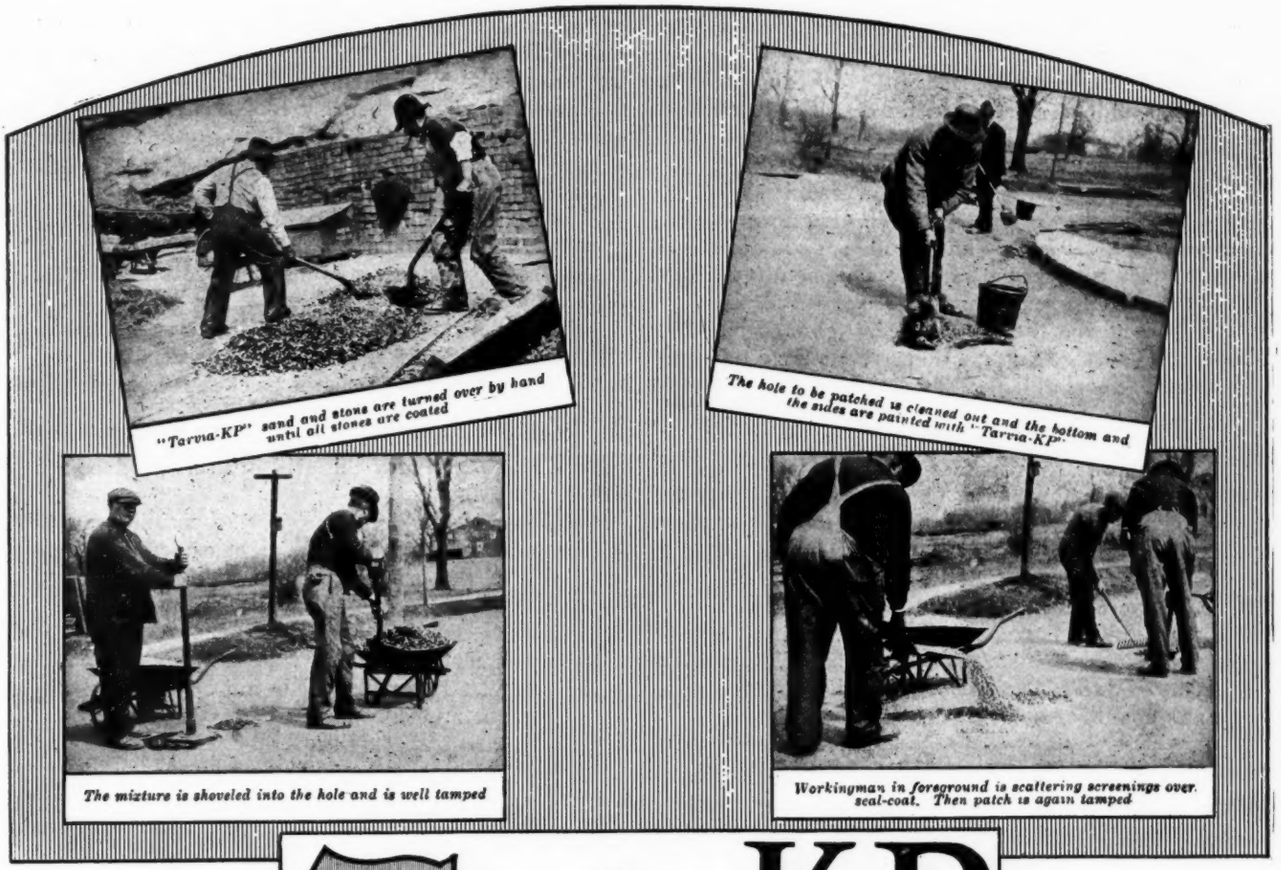
Bitumen

Use a bitumen that can be applied easily without heating. It is much more convenient, less expensive, and gives equally good results. The amount required will vary with the condition of the surface. A new road will require a full half gallon to the square yard, and possibly more, while a road that has been previously treated will require less than that amount. There are more failures from using not enough bitumen than from using too much.

It is best to apply ¼ gal. of bitumen at the first application, allowing 24 hours for penetration before the second application.

Following the second application of bitumen for the first surface treatment, an absorbent covering of sharp, clean torpedo sand or stone chips not to exceed ½ in. in size should be applied. This will absorb all excess bitumen, fill the holes in the road surface, and form a carpet which will protect the stone surface from wear and displacement.

The best method of applying the sand or stone chips is to deposit them in small piles along the shoulders of the road and apply by hand with a square pointed shovel as required. In many instances it is impractical to deposit the absorbent along the roadside. In this event the material is spread by hand from a motor truck or wagon. One cubic yard will cover properly about 120 sq. yds. of surface.


"Tarvia-KP" sand and stone are turned over by hand until all stones are coated
The hole to be patched is cleaned out and the bottom and the sides are painted with "Tarvia-KP"
The mixture is shoveled into the hole and is well tamped
Workingman in foreground is scattering screenings over seal-coat. Then patch is again tamped

Tarvia-KP

FOR COLD PATCHING

Road repairs *now* save money next spring—

If your roads are scarred from summer traffic, prompt patching with "Tarvia-KP" will save expensive repair work in the spring of next year.

The fall and early winter is the logical time to make economical repairs that will put your roads in prime condition during the winter.

"Tarvia-KP" used now, and whenever your roads are free from snow, will make small patches answer where large ones would be required next spring. And the time you save can well be used next spring in the work of road surfacing and new construction.

"Tarvia-KP" is unequaled as a quick, dependable, ever-available patching material for every type of road. It requires no heating, is extremely easy to handle and will stand up under the heaviest traffic. Freezing does not injure it.

Address our nearest office, outlining your road problems and get the free advice of our trained specialists.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit New Orleans Birmingham Kansas City Minneapolis Nashville Syracuse Salt Lake City
Seattle Peoria Atlanta Duluth Milwaukee Bangor Washington Johnstown Lebanon Youngstown
Toledo Columbus Richmond Latrobe Dallas Bethlehem Elizabeth Buffalo Baltimore

THE BARRETT COMPANY, Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax N. S. Sydney, N. S.

Keep travel off the surface for at least 48 hours after the absorbent is applied.

Each succeeding surface treatment will require a little less bitumen and an increase in the size of stone chips used, until in the fourth or fifth year stone from 1 in. to 1½ ins. in size may be used.

As the material used is increased in size, it should be well rolled into the surface and will soon form a new wearing surface. It is very important that surface treatment be applied early in the season. The months of May and June are the proper time.

Counties requiring the use of several cars of bitumen annually are constructing one or more concrete oil storage tanks. The cost of a 36,000 gal. tank is approximately $1,000. Plans for construction of these tanks will be furnished by the commission upon application.

Where this method of surface treatment is followed, a macadam road should have a better wearing surface at the end of almost any period of years than when first built, except under extremely heavy traffic conditions.

(One of the 36,000 gal. oil storage tanks was built at Portage, Columbia County. This is a reinforced concrete tank 20 ft. in diameter and 20 ft. in length, with a concrete roof. The tank was built in 1918, under the supervision of J. T. Henton, County Highway Commissioner, at a cost of about $1,000.)

Bituminous Macadam

Bituminous macadam requires practically the same method of surface treatment as is described under surface treatment of water-bound macadam, the only difference being that bituminous macadam surface does not need surface treatment as early in its life or as frequently as a water-bound macadam. However, it should be surface treated once every two or three years and if good bituminous material and clean hard stone chips are used, the surface treatment will build up the wearing surface and the road should remain as good if not better than when originally built.

Concrete Roads

It is economy to have a small maintenance crew go over all the concrete roads in the county twice each year. Such a crew consists of a foreman, one team or motor truck hauling the material, and four laborers, equipped with a tar heating kettle. This crew covers under average conditions all the joints, cracks, and small pits in from one to two miles of 16 or 18 ft. road in one day, at a cost of from $25 to $75 per mile for labor and materials. The tools used consist of a wheelbarrow, two fibre street brooms, two wire brooms, a couple of shovels, and a pouring pot having a round spout.

Cracks and Joints

Two men are utilized to sweep all cracks clean with the wire brooms, after which a man with a pouring pot fills the cracks with a special Tarvia "X" which is heated to about 225 deg. Fahrenheit. It is then allowed to stand in the crack for a few minutes to prevent "bubbling" out in case the sand is wet. The sand, which should be dry and coarse, is spread with a shovel over the crack and into the tar, and the whole is left for traffic to iron out.

On many of the older concrete surfacings, especially those where armour plate was used to protect the joints, we find that many joints are appreciably higher than the balance of the pavement. This disagreeable feature is emphasized in many instances by the improper application of the tar in filling the joints. An excessive amount of tar is often poured which runs over the edges of the opening and results in a higher joint than before.

Milwaukee County had more of this trouble than any other county in the State, and they have recently devised a machine for removing the old excess tar and cutting down the joints, both the concrete and steel.

A small air compressor and pneumatic chisel are used, operated by a gasoline engine. This gives very satisfactory results and removes the disagreeable feature of a high joint.

Care must be taken not to over-fill the cracks and joints with the tar. If the tar is allowed to spread over 3 or 4 ins. of the edge of each slab it will protect the slab from wearing and there is soon a noticeable difference between the portion protected and the portion unprotected and after a few years wear this will in itself produce a high joint.

To fill cracks and joints properly, especially on grades, it is good practice to spread a light bank of sand along each side of the crack or joint which will prevent the bitumen from spreading. It will also insure the joints being entirely filled. After the bitumen has been allowed a reasonable length of time for penetration, the sand can be swept over the crack and if more sand is necessary it can then be applied.

This method of repair prevents the edges of the concrete from spalling and chipping, and no water can penetrate to the subgrade to freeze and heave the concrete. The work is done preferably in dry, hot weather, first as early in the season as the weather will permit and again near the close of the season.

Depressions and Holes

In case small depressions occur, the time to repair them is when they appear. The best method of repair is as follows:

The surface is first swept with a steel broom to loosen the dirt; after this, the spot is thoroughly swept with fibre street brooms. To remove the fine dust which the steel brooms leave behind, ordinary house brooms are used which leave the surface fairly clean.

The depression is then covered with hot Tarvia "X," then with coarse sand or screenings, and opened to traffic. In case the depression is of considerable depth, or what might be called a hole, one of two methods is advisable:

First (in case you want to avoid delaying traffic), clean the depression as already described and then paint it with tar, upon which bring the hole to grade with crushed stone, being careful not to have the stone as large in size as the depth of the depression. Tamp the stone in place with hand-tampers or roll with a roller, if one is available, and fill the voids with a heavy bituminous road binder, allowing about ¾ gal. per sq. yd. per in. in depth. Cover the surface with torpedo sand or stone chips.

The second method is to cut the poor place out entirely and after trimming the hole and thoroughly sprinkling the sides, fill with the same mixture as was used in the original road. After pouring the concrete, treat the same as in reconstruction.

Small defects due to balls of clay, sticks or coal getting into the aggregate may be best repaired as described for shallow depressions. The same is true of battered joints or cracks that may appear.

WATER WORKS SECTION

WELL TESTS—THE BASIS FOR PUMP SELECTION

By George M. Shepard, Assoc. Mem. Am. Soc. C. E., Associate with L. P. Wolff, Consulting Engineer, 1000 Guardian Life Bldg., St. Paul, Minn.

In municipal practice it is frequently found that pumping machinery is purchased and installed without reference to the special service which it is to perform or the conditions under which it is to operate. Before selecting the type of pump which is to raise water directly from a well it is important to know the yield for different elevations of water surface below ground level. If at all possible, tubular wells should be thoroughly tested before pumping machinery specifications are drawn up. A small expenditure for a complete test will more than amply repay itself in the additional economy of operation of a pump, the design of which is based upon complete information.

Considerations Affecting Choice of Pump

The type of pump to be specified will depend upon different conditions, such as yield, water level of well, continuous or intermittent operation of pump, character of service and population to be served. For shallow tubular wells or wells where the pump may be placed close to water level either on the surface or in a pit, direct motor driven centrifugal pumps with suction drop pipe and foot valve inside of the well casing are perhaps the most economical method of direct pumping for isolated units or small installations. Frequently a group of shallow tubular wells are connected to a single suction line and the supply pumped by a vertical motor driven centrifugal pump, the pump being placed in a pit below the normal water level. Such a pump may be driven by a vertical motor and shaft, the motor being placed in a small house at ground level above the pit. The supply is frequently taken from large open wells in the same manner with vertical motor and shaft driven centrifugal pumps.

Where the required supply can be obtained within the limits of suction, i. e., for practical purposes, 22 or 23 ft. and where a foot valve or proper priming facilities are provided a reciprocating power or steam pump may be used. The writer has observed a suction lift as high as 26 ft. under good conditions of pipe work.

Where the supply cannot be obtained within the suction limits of a pump set at ground surface or in a pit, either a deep well cylinder pump, an air lift or a vertical motor driven turbine centrifugal pump may be used. Where only one well is available and storage is not sufficient to tide over the period required for repairs necessary for a deep well cylinder pump or a turbine pump, the air lift has many advantages provided sufficient submergence can be obtained for satisfactory operation.

Very frequently pumps are specified upon the basis of existing wells in the vicinity. This method frequently gives rise to erroneous results especially in rock and gravel formation as crevices and veins in rock and pockets in gravel always affect the yield of a well.

Two Examples of Well Tests and Pump Selection

As an example of conditions developed by tests upon which different types of pumping machinery were specified are the two following cases.

Example No. 1 is the well at Hinckley, Minn., which

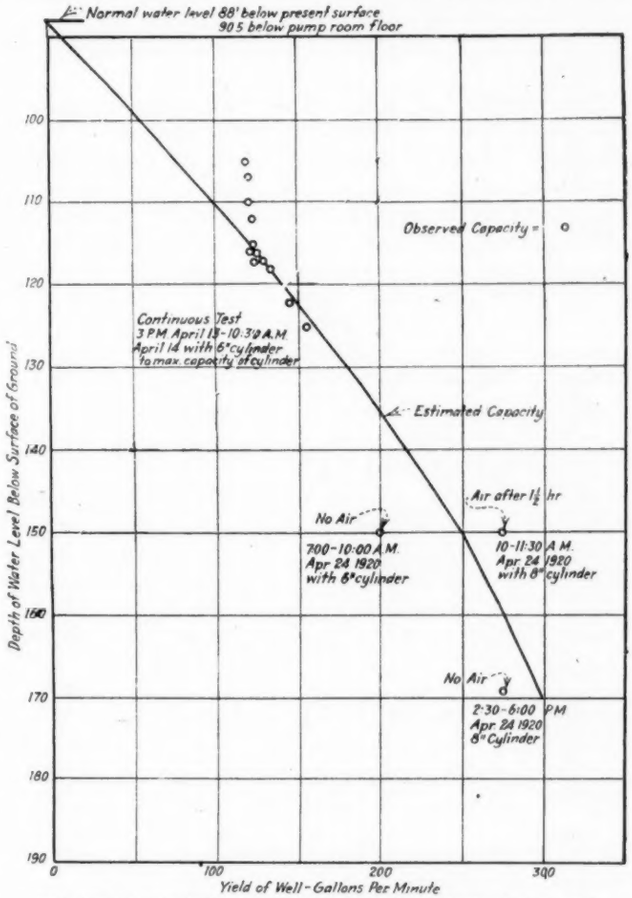


DIAGRAM SHOWING RESULTS OF TESTS ON 12-IN. WELL, 380 FT. DEEP AT PIPESTONE, MINN.

was drilled in 1919. This well is 10 ins. in diameter, 400 ft. deep and cased to rock at 23 ft. below the surface. The water stands normally in the casing at a distance of 14 ft. below the ground surface. The rock formation consisted of alternate layers of hard and soft sandstone, the soft layers being very reddish in color. Upon completion the well was tested with a 6 in. cylinder placed with the bottom of cylinder 35 ft. below the surface, and the speed of the piston was increased until air was drawn in at the bottom of the cylinder, the discharge of the pump being 190 gals. per minute at this point. By lowering the cylinder to 47 ft. the discharge was increased to 216 gals. per minute.

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Centrifugal Pump Specified

Inasmuch as a 200 gal. supply, in connection with the storage tank, was sufficient for this village with a population of 800, it was determined to place a direct motor driven centrifugal pump in a pit at a depth of 11 ft. below ground surface or just above the level to which the water normally rose in the casing. A centrifugal pump for the required lift, including suction, was specified for the actual discharge, with a drop pipe 30 ft. long and foot valve inside of the casing. The final test of pump showed that about 220 gals. per minute were being discharged against normal head when full suction lift was developed. This gave an economical installation and one requiring little attention, which is an important item in a small city or village without a regular water works superintendent. The test was carried on in this case until the well cleared, requiring 71 hours and a cost of $248 for the test and pumping, the labor and equipment being furnished by the well driller.

Example No. 2 is a well at Pipestone, Minn. This well is a 12-in. well, 380 ft. deep, cased to rock at a depth of 9 ft. The rock consisted of a pink and reddish quartzite from a depth of 87 ft. to 177 ft. Between 177 and 220 ft. a crevice in very hard quartzite was encountered, requiring blasting. Between 220 and 380 ft. a softer material having the appearance of a dense sandrock was penetrated. Upon the completion of the well the water normally stood at elevation 88 ft. below the surface. The results of the tests of the well are shown in the accompanying diagram, the first test being made with a 6-in. cylinder, and the second with an 8-in. cylinder.

An Air Lift Specified

On account of the difficulty in obtaining water in this particular region for a city with a population of 3,000, it was necessary to provide for continuous pumping of both the new well and the old well located in a different portion of the city. A reservoir was provided near the station, so that the well may be pumped practically continuously. The test indicates that for a supply of 200 gals. per minute the pump would have to be placed at a depth of 140 ft. below the surface of the ground, which for a cylinder pump would require long pump rods. In this case an air lift was specified on account of the absence of reciprocating parts and the greater reliability of an air lift for continuous service if installed with proper submergence.

It is believed that these two examples give extremes which may be met with in ordinary practice and illustrate the necessity of well tests as a basis for preparation of pump specifications.

MUNICIPAL WATER WORKS CONSTRUCTION AT POST-WAR PRICES

By Maurice R. Scharff, Asst. Chief Engineer, Morris Knowles, Inc., Engineers, Pittsburgh, Penna.

Some of the most trying problems of managers of municipal water works, these days when prices are constantly changing (in general to higher levels), arise out of the necessity of carrying out urgently needed construction under price conditions widely different from those at the time when the plans and financial provisions for the work were made. The managers of municipally owned plants are faced by even greater difficulties in this respect than those of company owned plants, owing to the restrictions with which municipal bond issues and construction contracts are hedged about.

Postponements Not Always Possible

In most cases, the difficulties have been so great that the postponement of the work, in the hope of better days to come, has seemed the only way out. In some cases, however, the demands of public service have been so urgent as to make postponement a source either of serious danger, or of the restriction of growth of a healthy community. Numerous examples can be found where the officials concerned have courageously faced the situation, and where, with water works material and labor costs advanced 100 to 200 per cent, and under financial conditions prohibiting the securing of additional funds, they have schemed and planned, and cut and rearranged, so as to supply in devotion and ingenuity what they lacked in money, and to secure for the public as great a proportion of the improvement of service planned as was possible with the funds provided.

Expedients Adoped at Elyria, Ohio

An example of this kind is offered by the new water works now being constructed under the direction of Mayor A. R. Jones and Service Director H. A. Beck for the City of Elyria, Ohio. An account of the expedients that have had to be adopted in connection with this work it may be of interest to other municipal officials who are faced by a similar urgent need of improvements planned some time ago, and postponed until the present time.

In 1918, the City of Elyria had a report prepared on the requirements of its water works system, and a new filter plant and pump station, and an additional force main, were recommended, at an estimated cost of about $750,000. Shortly afterward, a bond issue of $1,000,000 was authorized by vote of the citizens. Under the unsettled conditions existing at the time, it is natural that there should have been some hesitation about proceeding with the work. But the age and condition of the existing plant and force main made indefinite postponement dangerous. In the summer of 1919, therefore, Morris Knowles Inc. were engaged as engineers and authorized to proceed with the preparation of plans and specifications for the work.

New Plant as Originally Planned

Plans were prepared upon the basis of a filter capacity of 12,000,000 gals. per day, with provision for ultimate extension of 48,000,000 gals. per day. The improvement included a pumping station with three turbine driven centrifugal low lift pumping units of 6 million gallons per day each, and a high duty horizontal crank and fly wheel pumping engine of 8 million gallons per day capacity, which with the existing high service pumps installed in the new station, would give a total high lift pumping capacity of 16 million gallons per day. Plans also provided for a 36 in. cast iron, wood, or steel force main, paralleling an existing 20 in. cast iron main, 23,800 ft. long from the site of the plant at Lake Erie to approximately the city limits of Elyria. A general plan of the plant as originally designed is shown herewith.

Pipe and Pump Contracts

The first work on which bids were taken was the pipe (materials only) and the pumping engines, contracts for which were let in January, 1920, as follows:

Steel Pipe—

854 tons at $108 per ton	$92,232
516 tons at $115 per ton	59,340
Valves	6,165
Low lift pumps—turbine driven centrifugals, capacity 6 million gallons per day against 60 ft. head—each	5,850
High lift pump—horizontal crank, fly wheel unit, capacity 8 million gallons per day against 345 ft. head	50,500

Prices were continuing to advance, however, and by the time plans were ready for securing bids on pipe laying and construction of filters and pump station, it was evident that the amount of work to be done would have to be seriously curtailed.

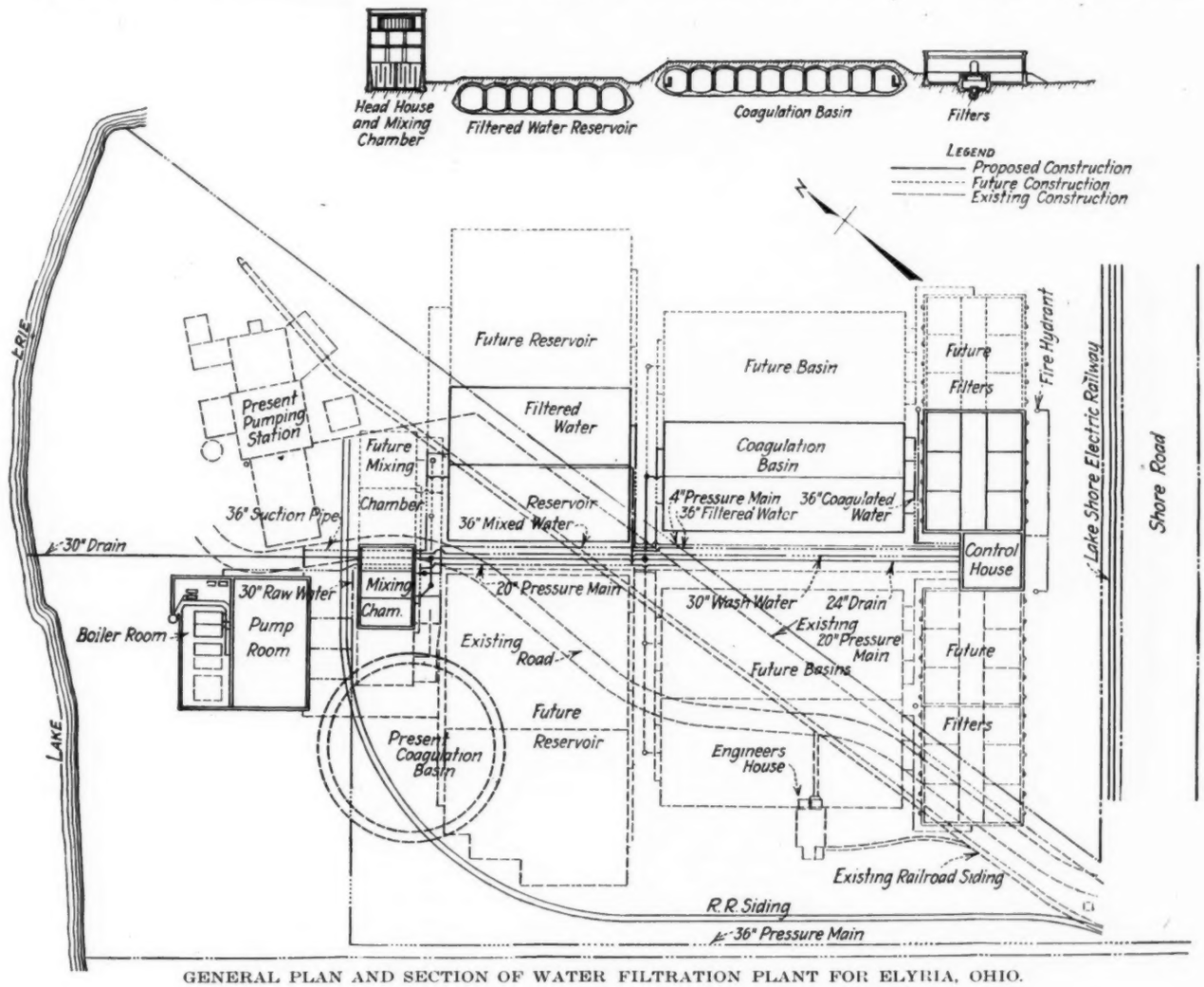
Pipe Laying Contract

Bids on laying pipe were first opened on Feb. 4, 1920, and resulted in one bid which would have made the total cost of laying $11.59 per ft., and the cost for the entire line of 23,800 ft., $275,840. This bid was therefore rejected, and new bids taken on March 17, 1920, separate contracts being advertised for hauling, trenching, and laying. Four bids were submitted this time, but contractors refused to agree to have their bids for the three contracts considered separately, and it was necessary to reject bids again and advertise a third time. This time the amount of work to be done was cut down to 17,400 ft., the contracts arranged for separate or combined bids on excavation and back filling, hauling, and laying of pipe, and contracts were finally let in May and June, 1920, for 17,400 ft., at $8.26, a total of $143,783.75.

Bids on Filter Plant and Pumping Station

Experience with the filter plant construction was similar to that of the force main. The complete filtration plant substructures, and filter plant equipment, was first advertised with bids to be received on April 26, 1920. One bid was received on the substructure totaling $539,547, and two bids on the equipment for filters with a capacity of 8 million gallons per day, the lowest bid amounting to $59,130. The substructure bid was unreasonably high and was therefore not accepted, and the filter equipment bid was rejected because it was not considered advisable to contract for the equipment until the substructure was under contract.

Bids were again received on June 21, 1920, for the filtration plant substructure, and filter plant equipment, with the exception of one filtered water reservoir of 1,000,000 gals. capacity, and two filters of a total capacity of 4 million gallons per day. On this advertisement separate bids for construction and materials were asked for,



GENERAL PLAN AND SECTION OF WATER FILTRATION PLANT FOR ELYRIA, OHIO.

previous advertising having indicated that certain contractors desired to be relieved of the financial responsibility of purchasing the materials. One bid was received on the construction of the filter substructure totaling $268,634, and several bids on various filter substructure materials, a combination of the lowest bids amounting to about $85,000. Three bids were received on the filter equipment, the lowest bid for construction amounting to $42,305, and for materials to $10,185. With the exception of certain material bids, all other bids were rejected. No bids were received on the construction of the pumping station substructure which was advertised at the same time, and which was as important to get under contract as the filtration plant substructure. Therefore, because it was not considered that the pumping station substructure could be included in the filtration plant substructure bid, the latter was rejected.

The construction contracts for the filtration plant and pumping station substructure were readvertised and bids received on August 18, 1920, the filtered water reservoir and certain other items having been omitted from this advertisement. In order to obtain bids on both the filtration and pumping station substructure, in addition to asking for separate bids, a combined bid was requested on both substructures. Separate bids were received upon the filtration plant substructure totaling $198,144, and the pumping station amounting to $109,705. The separate bids for these two substructures amounted to $307,849, while the combined bid amounted to $291,672, and therefore the latter was accepted.

It was decided to postpone the contracts for filtration plant and pumping station, superstructure, and filter plant equipment until later in the fall or until 1921.

Contractors

The work is now under construction with the East Jersey Pipe Co. supplying the Lock Bar Steel Pipe and Dan Pfahl Co., W. W. Carpenter & Son, and Anderson & Diedrick, contractors on the pipe line trenching, hauling and laying; Lupfer & Remick as contractors on the filtration plant and pump station substructures; and Worthington Pump & Machinery Corp. and Dravo-Doyle Co., contractors for pumping equipment.

Engineers

The work has been designed in the office of Morris Knowles, Inc., under the direction of John M. Rice, M. Am. Soc. C. E., Engineer of Design, and construction is under the supervision of C. W. Tarr, M. Am. Soc. C. E., Mr. H. A. Beck, Director of Public Service is the responsible official in charge for the city, and it is due to his courage and foresight that so much of the projected improvements are going ahead in the face of such formidable difficulties.

NEW WATER WORKS IMPROVEMENTS IN COLUMBUS, OHIO

By John H. Gregory, Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

In the summer and fall of 1908 the City of Columbus, Ohio, completed and placed in operation the last of the series of important water works improvements then undertaken. These consisted mainly of a masonry dam and storage reservoir, a water softening and filtration works, a new pumping station to replace the two existing pumping stations, and duplicate force mains connecting the new works with the distribution system in the city.

Need for Water Works Extension

With the steady growth of the city, Columbus having increased in population from 181,511 in 1910 to 237,031 in 1920, these water supply works have at times of very heavy draft (the city being on direct service) been taxed to supply adequately all of the water needed. This was especially noticeable during the cold winter of 1917-1918, when a maximum peak load of 182 per cent. of the daily average for the year was reached, and also during the hottest part of the summer of 1918, when the maximum peak load ran up to 209 per cent. of the daily average.

Although the maximum peak load did not occur during the winter of 1917-1918, nevertheless, the works were more severely taxed during this cold period, owing to the fact that the total volume of water pumped day in and day out, for several consecutive weeks, was very greatly in excess of the daily average for the year. Doubtless other works in the country, furnishing water by direct service and having practically reached their safe capacity, underwent a similar experience.

Present Water Works

The present water supply is taken from the Scioto River across which stream, at a point about 5.5 miles above the city, a curved masonry dam, about 1,000 ft. long, was built during 1904 and 1905. This dam, which is known as the Scioto River Storage Dam and which raises the water level in the river about 30 ft., forms an impounding reservoir about 5.8 miles long. The reservoir, named the Scioto River Storage Reservoir, has an area of water surface at the elevation of the spillway of about 363 acres; the total storage capacity is 1,720 million gallons of which 1,487 million gallons are available for use.

Below the dam, the river channel carries the water from the reservoir to a point about 4.5 miles downstream where a low intake dam serves to form a pool from which water is raised by low-lift pumps to the water purification works located nearby. At these works, which have a maximum capacity of 30,000,000 gals. daily, corresponding to an average water consumption of 22,300,000 gals., but with piping arrangements which will admit of extension of the works to a maximum capacity of 48,000,000 gals. per 24 hours, sufficient, however, only for an average daily water consumption of 35,000,000 gals., the water is softened, filtered and chlorinated.

From the filtered water reservoir, holding 10,000,000 gals., water is taken to the pumping station in which there are three vertical, triple-expansion, reciprocating pumps, with a total capacity of 65,000,000 gals. per 24 hours, which deliver the water to the city through two 36-in. cast-iron force mains.

Planning Increased Supply

The city was aware that the safe capacity of the works just mentioned was limited, and in the fall of 1918 retained the writer, who was in charge of the design and construction of water and sewerage improvements built in Columbus during the five years, 1904-1909, to make a thorough investigation of the water supply situation, and to report on the best means of furnishing the city with

an increased water supply. This investigation covered several months, and as a result a series of reports were made during the spring and summer of 1919 in which the whole water question was fully discussed and set forth in detail. Definite recommendations were made covering not only the enlargement of certain portions of the existing works but also the construction of additional works at a total estimated cost of $3,000,000. And in the fall of 1919, at the November election, a bond issue of the above amount was authorized by vote of the people.

While in the reports submitted by the writer, recommendations were made covering not only the enlargements and new works absolutely needed at the present time, as well as certain works needed at a later date, it is the purpose of this article to outline briefly only such works as the city proposes to construct in the near future.

Bureau of Water Works Extension

The first definite step taken by the city was to provide for an engineering organization to design and supervise the construction of the work. Accordingly, an ordinance was passed by the city council creating, in the Department of Public Service, under the Division of Water, a Bureau of Water Works Extension, with the following authorized personnel:

Consulting Engineer	
Engineer in Charge	
Office Engineer	
Field Engineers	2
Assistant Engineers	4
Transitmen	4
Rodmen	8
Draftsmen	6
Inspectors	2
Stenographers	2

This bureau, which will function as a part of, and will co-operate with, the Division of Water, has been in operation since the first of May, and appointments under the Civil Service have been made as rapidly as conditions have warranted. It is not expected, however, that the personnel will be complete until active construction of the larger works begins next year. Starting, now, with the supply works, extended investigations clearly demonstrated that, for a very considerable period of years at least, the best interests of the city would be served by building the new storage works on the Scioto River, the present source of supply. It is proposed, therefore, to build a new masonry dam, some miles above the Scioto River Storage Dam and Reservoir, and there impound sufficient water, which, with that available in the present storage reservoir, will provide for an average capacity of 55,000,000 gals. daily of filtered water.

Proposed New Masonry Dam

The new dam, which will be known as the Dublin Dam, will be of the overflow type, approximately 70 ft. in height to the spillway, and something over 1,500 ft. in length, including the abutment sections. The reservoir, which will be called the Dublin Reservoir, will contain roughly 6,575 million gallons of available storage above low water, will have an area of water surface of about 900 acres at the elevation of the crest of the overflow, and will be about 8 miles in length.

The drainage area above the Dublin Dam is about 996 square miles; at the Scioto River Storage Dam downstream, the drainage area is 1,053 square miles.

From the Dublin Reservoir the water will flow down the river to and through the present storage reservoir and thence down the river again to the intake dam where it will be pumped to the purification works by low-lift pumps, softened and filtered, and then repumped by direct service machinery into the force mains connecting with the city distribution system.

Proposed Additional Filters

At the purification works, eight additional filters of 3,000,000 gals. daily capacity each will be built, or a total addition of 24,000,000 gals. daily. This will bring the gross capacity of the softening and filtering works up to a total of 54,000,000 gals. daily, sufficient to provide for peak loads and to allow one filter at any time to be out of commission for inspection and overhauling. The net capacity of the purification works, when enlarged, will be about 35,000,000 gals. daily. At some later date it will be necessary to build additional filters, settling basins, chemical house, etc., to bring the purification works up to an average net capacity of 55,000,000 gals. daily, that for which the supply works will be built.

The storage of filtered water will be increased from 10,000,000 to 16,000,000 gals. by the enlargement of the present clear water reservoir, provision for which was made when the original works were built.

Additional Pumping Equipment

In the pumping station the pumping capacity will be increased by the addition of one low-lift and one direct service pump, each with a capacity of 30,000,000 gals. daily.

The intake dam, which is only a low diverting dam a few feet in height, will be raised slightly to provide a larger pool from which to pump raw water. This will facilitate the operation of the pumping station as larger and larger quantities of water are taken from the river, (in dry weather no water is allowed to run to waste over the intake dam), will increase the screen area in the intake gate house, and will decrease the suction lift on the low-lift pumps.

New Force Main

To provide for pumping larger quantities of filtered water to the city an additional force main 42 ins. in diameter will be laid running from the pumping station to the northerly part of the city, and a 42-in. Venturi meter, with bypass, will be inserted in this line so as to continue metering all of the water pumped as has always been the practice since the new works were started in 1908.

Columbus has been growing rapidly on the high ground to the north, with the result that the pressure has not been such as always to provide satisfactory service at certain hours of the day. To remedy this, a high service district has been created by cutting out a portion of the distribution system and cutting in a high service pumping station with two 5,000,000 gal. daily electrically operated centrifugal pumps. These pumps were installed last year, in a building constructed jointly by the water works and electric light departments, in accordance with the recommendations made at that time.

Reinforcements of the distribution system will be carried out at various points in the city to meet increasing

demands, and additional cross-connections between some of the main feeders will be made.

Briefly then, the above gives a rough outline of the water works program on which Columbus is setting out in order to keep abreast of the growing needs of the city.

Progress on the New Work

In the field, surveys of the dam and reservoir site are under way and boring machines are at work locating the exact surface of the rock and the nature of the covering. In the office, substantial progress has been made in working up studies and designs for such parts of the works as will be first put under construction.

Personnel

The work is being carried out under the general direction of Mr. W. H. Duffy, Director of Public Service, and Mr. Jerry O'Shaughnessy, Superintendent of Water Works. The engineering work is being directed by Mr. C. B. Hoover, Engineer in Charge, Mr. Arthur R. Holbrook, Office Engineer, Messrs. C. B. Cornell and V. C. Norton, Field Engineers, and by the writer, as Consulting Engineer.

FEATURES OF NEW WATER WORKS AT MINOT, NORTH DAKOTA

By Frederic Bass, Consulting Engineer, Minneapolis, Minn., and E. J. Thomas, City Engineer, Minot, N. D.

The City of Minot is located in the northwestern part of North Dakota in the valley of the Mouse River. It is on the main lines of both the Great Northern and Soo Line railroads and serves as a distributing point for an agricultural area within a radius of from 200 to 300 miles to the west, north and east. The population of Minot is at present 10,400, having grown at a steady rate from 6,200 in 1910 and 1,800 in 1900.

Fig. 1. VIEW OF CITY PUMPING STATION IN OAK PARK, MINOT, N. D.

The need for a municipal water supply was felt in 1900 and in 1904 a supply was introduced from the Mouse River by pumping directly into about 2 miles of 4 in. mains. In 1905 it was realized that a new water supply and distribution system was necessary and test wells were sunk in search of ground water. The results were apparently unsatisfactory and after considerable discussion it was decided in 1908 to use a filtered supply from the Mouse River. In 1909, a new system, consisting of a combined pumping station and rapid sand filtration plant together with 10½ miles of mains, was installed.

This installation was more or less unsatisfactory, due partially to defects in design. As the demands of the growing city increased the plant became inadequate and in 1915 the City Comissioners engaged Prof. H. E. Simpson, Assistant State Geologist, to make a brief survey of

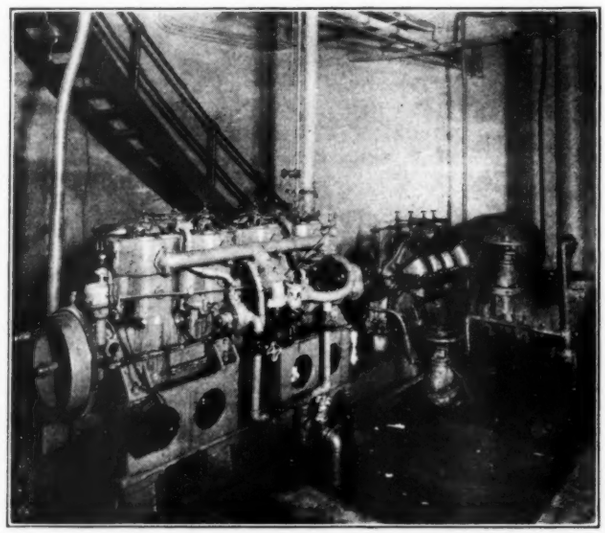


FIG. 2. VIEW OF PUMPING UNIT IN OAK PARK STATION, MINOT, N. D.
Four-Stage Centrifugal Pump Mounted Between 150-H. P. Electric Motor and Reserve Eight-Cylinder Marine-Type Gasoline Engine.

the situation. Professor Simpson advised a more extended study of the situation and in May, 1916, one of the writers, Frederic Bass, was engaged to report on a new water works system for the city. This report was made in November of the same year, after a study of the hydrology of the Mouse River and of the geological conditions. The result was the adoption of a ground water supply.

Ground Water Supply

In the valley of the Mouse River there are found sedimentary deposits of varying character and thickness resulting from the ice sheets which twice invaded this region. Below these are formations of continental origin including lignite deposits and of earlier origin are various clay and marine deposits. Underlying these and extending over nearly the whole of North Dakota is the cretaceous formation known as Dakota sandstone deposited presumably by a great inland lake. It seemed quite possible that the glacial deposits would furnish an adequate water supply, since several small drilled wells were in successful operation; accordingly these were explored.

In the investigation of the sources of supply the surface formation was first examined by means of jetting six 2½ in. test wells from 30 to 60 ft. in depth. These wells sunk at intervals of approximately 100 ft. along the banks of the Mouse River disclosed a water bearing sand, but on account of its extreme fineness a small yield. Two 4 in. and later two 5 in. wells were drilled to depths from 120 to 132 ft. and the coarse sand and gravel found

gave indications of ample water. It was decided to drill a 10 in. well for finally testing the capacity of the source. This was done in the winter of 1916-17 and a test made in March, 1917, gave a yield of 100 gals. per minute. In May of the same year a 12 in. well was drilled to a depth of 132 ft. and a 40 ft. No. 20 brass screen placed. A 100-hour test showed a capacity of 370 gals. per minute. Later when the permanent pumping machinery was installed, a continuous flow of 890 gals. per minute was yielded for a period of one week.

The investigation of the records of stream flow in the Mouse River as determined by Professor Chandler and recorded by the United States Geological Survey showed maximum floods of 2,100 sec.-ft. but for one period of four months in 1910 a mean flow of 0.5 sec.-ft., or 323,000 gals. per day. The demand for water by the city in 1917 was more than twice this amount, and only because of the absence of very dry years had the city already escaped a serious water shortage. It was immediately evident that the Mouse River would not furnish an adequate supply of water for the future. Moreover the ground water would not require filtration and was very much softer, the river water having a permanent hardness of 212 and the ground water 35.

Pumping Station

The necessity of immediately developing the ground water being apparent, the City Commissioners ordered plans made for a pumping station, and a 3,000,000 gal. reinforced concrete reservoir, to be constructed on the hill south of the city at the site of the existing elevated tank. The distribution system already included a 100,000 gal. elevated steel tank on a 80 ft. tower situated on ground approximately 180 ft. above the level of the ground in the major portion of the city. It was planned to divide the distribution system into two zones, all of the water being pumped to the new reservoir at ground level for distribution to the greater part of the city lying in the valley and a small part of the water pumped from this reservoir by two electrically driven centrifugal pumps, float controlled, to the elevated tank to supply the residences on the hill. A considerable saving in power for pumping is thus effected.

The pumping station was located at the 12 in. well in Oak Park. Mr. Andrew Fraser of Minot was engaged as consulting architect and in conjunction with Mr. E. J. Thomas designed the structure which consists of a circular concrete pit 30 ft. in diameter and 25 ft. in depth, surmounted by a pleasing park shelter house 40 ft. by 40 ft. in plan. Fig. 1 shows the character of the structure. The pumping equipment installed consists of a four stage centrifugal pump mounted on a common base between a 150 H. P. motor and an eight cylinder marine type gasoline motor, the latter being kept in readiness for possible failure of electric current. The pumping equipment is shown in Fig. 2.

Reinforced Concrete Reservoir

The concrete reservoir was designed in 1916-17 and constructed in the summer of 1919. On account of the inability of the contractor to finish the construction of the connecting mains the reservoir was not filled with water until June, 1920. It is circular in plan with a diameter of 150 ft. and a maximum depth of water of 22 ft. at the center and 14 ft. at the wall. Figs. 3, 4 and 5 show the design. A flat slab roof designed in accordance with the Chicago building ordinance was substituted for the beam and slab design shown. One feature of the loading of this slab is of interest. It was observed that in the sedimentation reservoir of the old filter plant that a considerable layer of ice resulting from condensation attached itself to the roof and in this design 60 lbs. per square foot was added to the live load to cover this contingency.

FIG. 3. VIEW OF 3,000,000 GAL. CONCRETE WATER RESERVOIR AT MINOT, N. D. FIG. 4. RESERVOIR, PUMP HOUSE AND ELEVATED WATER TANK AT MINOT WATER WORKS.

The reservoir was filled in the early summer of 1920 and a number of fine vertical cracks opened at irregular intervals in about one half of the panels. It was suspected also, and later verified, that leakage was taking place through the floor. The leakage which at first was as high as 45,000 gals. per day gradually decreased, but it was thought desirable to take measures to water-proof the entire structure on the inside. When the surface had become dry the cracks in the walls and floor were marked and then cut out to a depth of 1 in. and a mastic cement of the General Fireproofing Company troweled in. This cement consisted of a vulcanized chinawood oil holding in suspension asbestos fibre and a small amount of pigment. The entire surface of walls and floor was then painted with two coats of a bituminous paint. Some difficulty was at first encountered in securing a bond between the concrete floor and the paint, due to the difficulty in drying the floor. A thin layer of dry cement

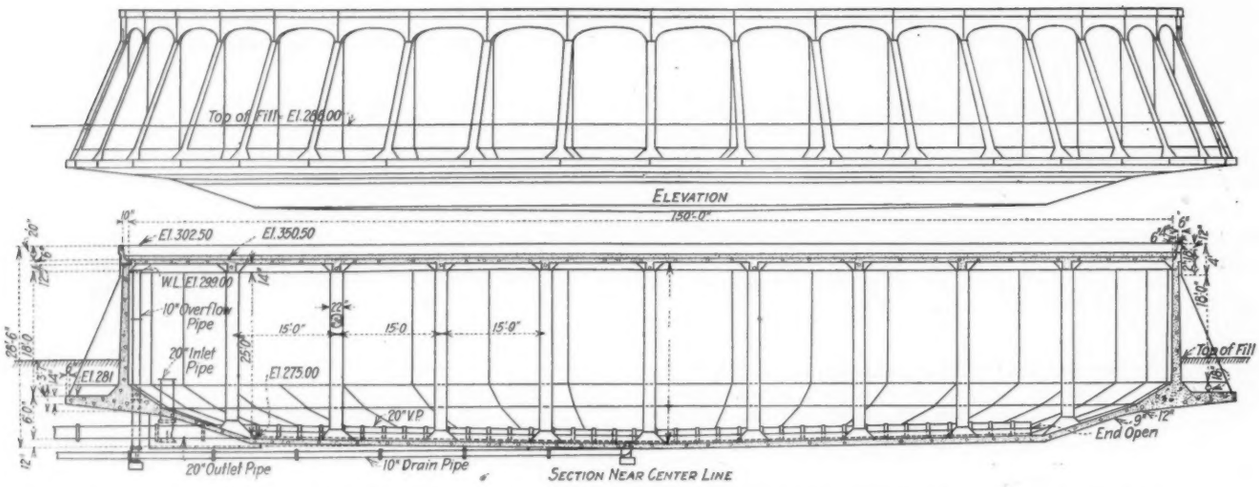


FIG. 5—ELEVATION AND SECTION OF 3,000,000-GAL. WATER WORKS RESERVOIR AT MINOT, NO. DAK.

spread over the floor absorbed the surface moisture and the paint was then applied.

On October 1, 1920, the reservoir was filled after receiving the treatment described. The reservoir is now watertight, showing only four or five damp spots on the outside surface.

POPULARIZING THE WATER UTILITY

By Robert E. McDonnell, of Burns & McDonnell, Consulting Engineers, Kansas City, Mo.

The business of selling water, whether from private or municipally owned plants, with few exceptions, is handled in a manner tending toward bankruptcy and failure rather than toward profits and success, due in a large measure to the failure of the water works officials to consider the public and conduct the water works with the apparent idea that the customers must have the water. Our almost universal practice of ignoring the public is a fault for which we are now paying the penalty, said Mr. McDonnell in addressing the Southwestern Water Works Association.

Publicity Campaigns

Just now, at a time when prices for all water works materials and operating costs are mounting higher and higher and increased rates must be secured, the water works officials, whether private or municipal, are forced to turn to the public and conduct a campaign of publicity of water works facts and information before an unfriendly or hostile public opinion. The facts about water, its purity, the plant and its condition are now given out in a defensive attitude and the lack of familiarity of the consumers with the plant and its needs shows the need of keeping before the public an educational campaign of popularizing the water, light, gas, or other utility. This campaign of publicity would have been easier had it been conducted constantly rather than spasmodically in time of stress.

A large proportion of public clamor against a utility is because the public is not posted as to the facts pertaining to the utility and its relation to the welfare of the citizens.

At the Collector's Window

The knowledge and impressions of the public regarding water works matters are in most cases gained at the water collector's window and through the monthly or quarterly bills mailed out. I wonder how many have ever compared the affability, courtesy, and patience displayed by the clerks selling water with that of the clerk selling dry goods? Can you imagine a clerk in a dry goods store approaching a customer coatless and with a pipe in his mouth? Yet, at a water collector's window such a thing is not unusual.

Friends for a municipal water plant are just as important as for a private enterprise, for on the attitude of these friends depends the character of improvements. Appeals to the public for funds must be constantly made, either new bond issues or tax levies are required in any growing community and the readiness with which the public responds to these appeals depends upon the friendly or unfriendly attitude toward the water works plant and its officials.

A water works official recently said: "We must have new filters, we need new pumps, and we need new mains, but most of all we must have higher rates, but it will be a hard job to convince the public of these necessities because we have silently continued operating, hoping to avoid the necessity of laying our case before the voters."

Undeveloped Territory

In one water plant a fourth of the people along the street were passed by without water connections. One water works individual in an Indiana city, who prided himself on the popularity of his management has discovered that on 100.9 miles of mains there are 2,567 vacant lots, or 48 miles of his extensions front vacant property, all suitable for residences.

Every vacant lot passed is a direct loss, although it is a prospective customer whose acquaintance and connection is needed. Statistics show that for towns of the same population some water plants have as low as 10 services per 100 people, while others as high as 27 services per 100 people. Out of a list of 31 cities in the Southwestern Water Works Association territory it is found that the connections per mile run from 13 to 87, with an average of 50 per mile.

Keep the Public Informed

I find the growth of the water plants, like that of most young children, is all to legs and arms until it becomes

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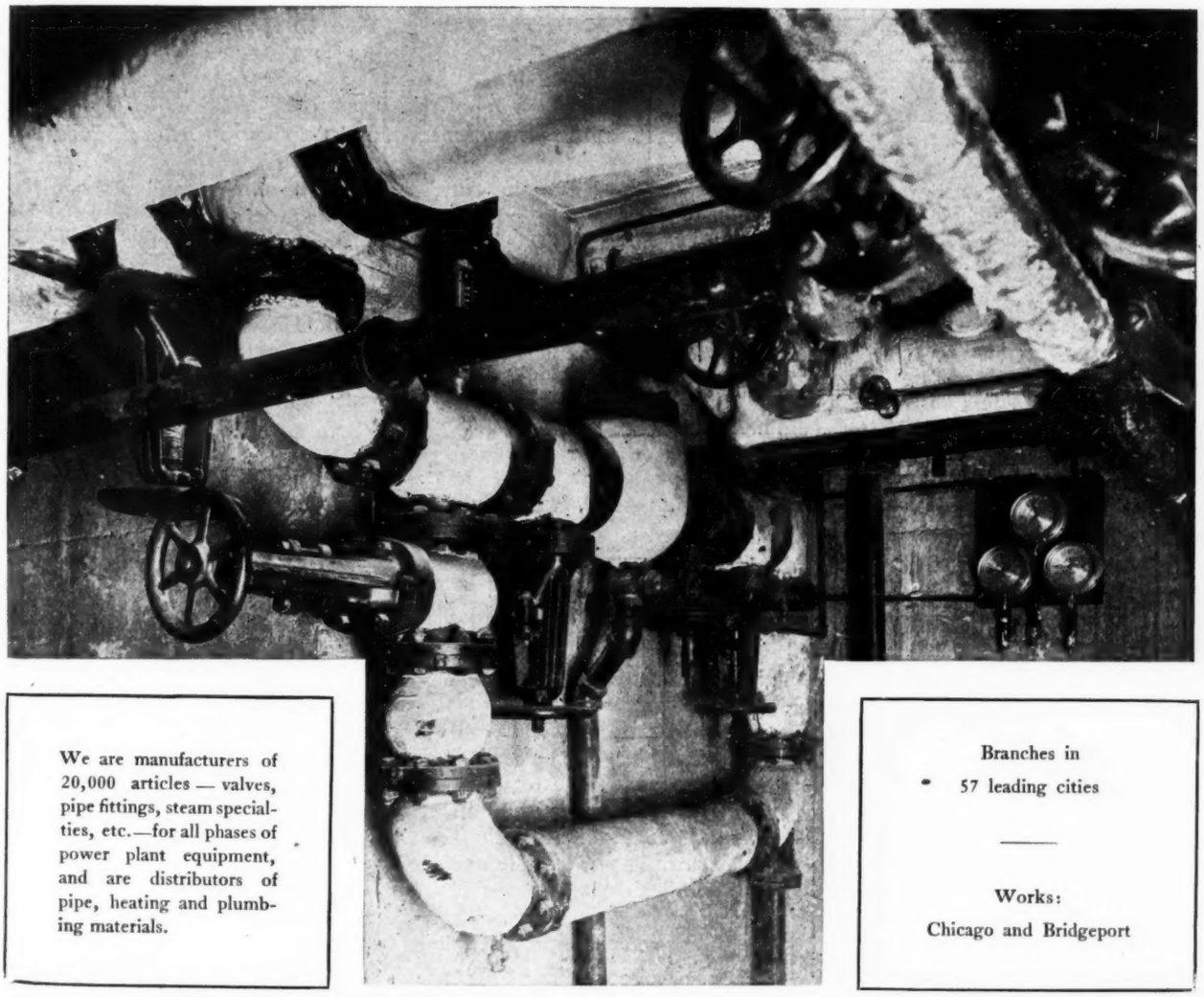

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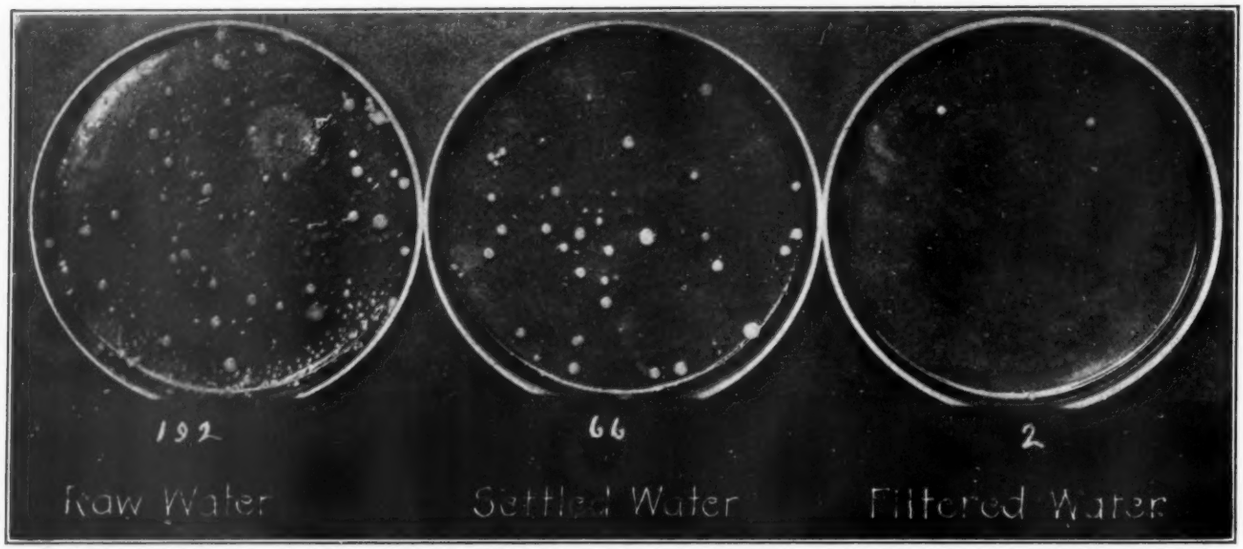
awkward, with nothing but extensions and no body to supply their wants, and in a few years the vital parts, such as supply pumps, reservoirs, etc., are behind the extensions. Then comes a breaking down of the system and a rehabilitation is necessary, which is doubly hard because the public must be told how and why it happened and the deterioration of the plant is often one that could have been avoided by constantly watching its growth, acquainting the public with the evidences of its inadequacy and providing for betterments before conditions became acute. This can best be accomplished by a complete program of future growth, showing what the plant will need in order to supply its growing condition. Let this program of growth go before the public in every possible way so there will be no shocks or surprises. Your rate of consumption from year to year, your rate of extension of mains, your pump capacity requirements, in fact every feature of the plant can be compared in graphical diagrams and curves showing the plant's needs. Supply them as news items on folders accompanying bills, as cartoons, and on the receipted cards. For example, Omaha never lets the public forget the saving resulting in the municipal ownership and operation of that plant, for the same rate charged under private ownership is still printed on the cards, and in red ink is printed the reduction in cost of water under municipal ownership.



PHOTOGRAPHS OF BACTERIA PLATES SHOWING DIFFERENCE BETWEEN RAW, SETTLED AND FILTERED WATER.

Pure Water a Great Civic Asset

The most common ailment of water works plants is that produced by permitting impure water to go into the mains. Pure water is an asset that no city can afford to be without. If your city does not have pure water you are without the essential qualifications of making the plant a success. After a pure water supply is established the publicity regarding its purity should always be kept before the public. The U. S. Public Health Service has fixed a high standard and when a water plant meets their requirements and sells water for train service this fact should be made known. Photographic bacteria plates illustrating the difference between the raw water and purified water, as per illustration, are always convincing and interesting to the public. Bottled waters are often sold where they are inferior to the quality sold from the water works plant. At Bay City, Mich., recently the bottled water companies carried large display ads telling of the bacteria in the city water. At Tulsa it is reported that bottled water sales exceed the revenue from the municipal filter plant. By a campaign of publicity from a city or company having pure water, there ought not to be a drop of bottled water sold.

Milk companies of many cities have recently inaugurated advertising campaigns to popularize milk, giving cartoons showing beautiful and healthful children, attributing everything to pure milk. Their statistics are convincing. The U. S. Department of Agriculture popularizes by cuts, drawings, pamphlets, and photographs, before farmers, the need of pure seeds. Pure water has more good sound arguments as a basis for advertising and popularizing than any other commodity.

At the Tulsa meeting of this Association, nearly three years ago, my sanity was somewhat questioned when I predicted greatly increased prices in all water works materials as soon as the Government removed the war time restrictions, and we have in the last five years experienced increases even greater than then predicted.

Price Advances

The following percentages of increase in the water works materials and labor is derived from figures from more than 100 water works officials in 36 states: Cast iron pipe increase, 245%; special castings increase, 191%; lead increase, 88%; meters (¾ in.) increase, 37%; valves (6 in.) increase, 107%; and coal increase, 98%.

Average increase in superintendents' salaries, 37%.

Average increase in other employees' salaries, 57%.

The alarming feature of the investigation shows that 79% of the 100 cities have received no raise of rates, yet practically all of the cities are in urgent need of an increase. Of the 21% of the cities securing a raise of rates, the average increase has been 49%.

The one fact preventing a uniform raise of rates to meet the corresponding increase in other commodities is the lack of public knowledge regarding the needs of the plant, its true condition, its value in dollars as a basis of

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rates and as an asset to the community, which facts ought to be clearly set forth and kept constantly before the public. If comparisons were made for use of the individual in the costs of all ordinary commodities, it would be found that water, although the most essential of all commodities is the lowest in cost.

If you will compare your meat bill, bread bill, fuel bill, picture show bills, or cigar bill with your water bill you will find the water the lowest of all.

You Tell 'Em, Bryan

Water needs popularizing both for the sake of our own health and happiness and for the future success of the water works business. We have now enlisted as a popularizer of water the great Commoner, W. J. Bryan, who recently said, "All hail to the drink of drinks—to water, the daily need of everything! It ascends from the earth in obedience to the summons of the sun, and descends in showers of blessing. It gives forth its sparkling beauty to the fragrant flowers; its alchemy transmutes base clay into golden grain; it is the radiant canvas upon which the fingers of the Infinite trace the rainbow of promise. It is the beverage that refreshes and brings no sorrow with it. Jehovah looked upon it at Creation's dawn and said, 'It is good.'"

NECESSITY OF COMPETENT SUPERVISION AND CAREFUL LABORATORY CONTROL IN OPERATING WATER PURIFICATION PLANTS

By Lewis I. Birdsall, Superintendent of Filtration, Waterworks Department, City Hall, Minneapolis, Minn.

Eternal vigilance is the price of pure water. Every water purification plant, from the smallest liquid chlorine installation to the largest and most complete filtration plant, should be operated under competent supervision and careful laboratory control.

Neglecting Small Chlorinating Plants.

The cheapness and demonstrated effectiveness of liquid chlorine, as a sterilizing agent for water supplies have induced many waterworks officials in Minnesota, as elsewhere in the United States, to rely on chlorine as the sole means of water purification. Such an installation may, however, merely afford a false sense of security. Failure to keep up the chlorine treatment continuously and in amount sufficient for sterilization of the water may mean a typhoid fever epidemic in the community. This danger is greatest among the smaller water works plants, where one man is frequently responsible for the operation of the pumps and the chlorine machine. The result is that the pumps get most of his attention and the chlorine machine is neglected.

Duplicate Installations of Liquid Chlorine Machines Are Imperative

There are many water works plants, and among them some that are not small plants, that rely for chlorine sterilization on one machine only, so that when it is necessary to change chlorine cylinders or to make necessary repairs, the chlorine feed has to be discontinued. Too much stress can not be placed on the necessity of duplicate installations of liquid chlorine machines wherever used so that when one machine is taken out of service the other may be put in service immediately and continuous treatment be obtained. There should also be kept on hand a supply of extra parts for the chlorine machines, so that ordinary repairs may be quickly made in case of emergency. Our state boards of health should require duplicate installations of liquid chlorine machines, and it would also appear that the manufacturers of the machines might be led to see the advantage to themselves, as well as to the various communities served, in making a substantial reduction in the selling price of two machines to the same purchaser as compared with the price of one machine. The price of repair parts should also be kept as low as possible, and all users of the machines be urged to keep a supply of extra parts on hand.

Chlorine cylinders that are in service should be placed on scales and a record be kept of the weight of the cylinders every hour, not only as a check on the manometer gauge of the chlorine machine, but also to accustom the operators of the plant to inspect the machines frequently to see that they are working properly. The scales prevent chlorine cylinders from going empty unexpectedly and the recorded weights serve as a check on the faithfulness of the operator, provided that the amount of water treated each hour is accurately determined.

Amount of Chlorine to Use.

But how shall we know that we are adding the proper amount of chlorine to the water in order to obtain sterilization at all times? There is no general rule for the amount of chlorine to use. The suspended matter, dissolved organic matter and the bacterial content of surface waters, especially river waters, are constantly changing. The amount of chlorine necessary for sterilization of the water is influenced by all three of these factors. A filtered water or a fairly clear and pure water requires less chlorine than does a turbid water, or one containing a large amount of dissolved organic matter. Whereas a treatment of three-tenths of one part per million (two and one-half pounds of chlorine per million gallons) may be satisfactory in the first case a much larger dose is required in the latter instance. Residual tastes and odors must be considered in the treatment of some unfiltered waters. A slight variation in the amount of chlorine added may mean either under-treatment and lack of sterilization or over-treatment and complaints from the water consumers. Sterilization takes place less readily in cold water than it does in warm water and so it is necessary to allow a longer period for the reaction in winter than in summer. Experience has shown that free chlorine disappears much more rapidly from the treated water when the water is passed through iron pipes than when it goes through a concrete conduit.

Laboratory Control Essential to Chlorine Regulation.

It is evident that in order properly to regulate the chlorine treatment there must be laboratory control. The test for free chlorine in the treated water, and the determinations of the number of bacteria and the presence or absence of B.coli in the untreated and treated waters offer such control tests. Because of the lag of forty-eight hours in the results of the bacteriological tests, made necessary by the incubation of the inoculated media, it is advisable, in most plants, to add sufficient chlorine to the water to produce a slight residual free chlorine content of approximately 0.05 part per million. Some waters,

as stated above, do not permit of over treatment, but such waters are comparatively few, and where they occur the treatment requires very careful supervision. In the majority of cases, therefore, the chemical test for free chlorine becomes the one on which we rely for sudden changes in the chlorine treatment and the test should be made several times each day. The bacteriological tests indicate the results of the treatment and demonstrate the purity of the treated water. They should be made daily on both the untreated and treated waters.

Chlorine is comparatively cheap, much cheaper than human lives, and therefore it is much more desirable to over-treat a water supply with chlorine than to under-treat it if reliance for purification is placed on chlorine alone. A chlorine taste in the water, even though it may be unpleasant is less harmful to the water consumers than a tasteless water that contains typhoid bacilli.

Chlorine sterilization is a valuable adjunct to other methods of water purification, but it should not be depended upon as the only line of defense between a seriously polluted water supply and the water consumers unless it is so used as a temporary expedient and then only under the most careful supervision.

Laboratory Control of Filter Plants.

The laboratory tests necessary for the control of a filter plant are more comprehensive and elaborate than those described for a chlorine plant.

Turbidity, color, alkalinity and the bacterial content of the untreated water usually determine the amount of chemical necessary for proper coagulation of the water before it goes to the filters. The same tests on samples of the water as it goes to the filters from the coagulation basins determine the efficiency of the pre-treatment. A properly coagulated and filtered water should have no turbidity and a color of ten parts per million or less. The bacterial content of the filtered and sterilized water should be as near zero as possible and B.coli should be absent in 50 cc. amounts of the water.

An odor in the untreated water may be caused by algae and a microscopical examination of the water will disclose the offending organism. Odors from manufacturing wastes are sometimes more difficult to eliminate from the water than are those from micro-organisms. Tests for odor should be made on both the untreated and the filtered water.

The alkalinity test demonstrates the presence of carbonates and bicarbonates in the untreated water and whether or not they are sufficient in amount to decompose the coagulant to be added. The filtered water should at all times have residual alkalinity as a safeguard against the presence of undecomposed coagulant.

Free carbonic acid frequently occurs in surface waters. A determination of the amount present should be made where lime is used in conjunction with iron sulphate as coagulant. The amount of free carbonic acid in the filtered water should be determined because of the part it plays in the corrosion of exposed iron surfaces in distribution pipes.

The test for residual chlorine is essential as already described.

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water supply are more easily answered if data is at hand to show that the filtered water is no harder than the untreated water and that the hardness of the water is greater at certain times of the year, due to natural causes.

Complete sanitary chemical and mineral analyses of the untreated and filtered waters are made each month in the larger filtration plants for the purpose of record. These are not necessarily essential for the purpose operation of the plant, but they are of value for reference.

Analyses of the chemicals used for water purification are valuable and there should be frequent tests of the chemical solutions that are added to the water.

The Most Essential Laboratory Tests for Filter Control.

The most essential laboratory tests for the proper control of a filtration plant are those for turbidity, color, alkalinity, residual chlorine, number of bacteria per cubic centimeter and B.coli. The data obtained from these tests will enable the operator to handle his plant economically and efficiently. He will, at all times, have the satisfaction of knowing the quality of the untreated water and the degree of purification obtained by the plant. The health of a community is the final test by which the purity of a water supply is judged, but the operator of a water purification plant, who knows each and every day that the water he is supplying is of the highest purity, has nothing to fear from health statistics.

A water softening plant requires certain special laboratory tests in addition to total hardness, alkalinity and free carbonic acid determinations. Only under laboratory control can a softening plant be properly operated.

It seems almost inconceivable that anyone should attempt to operate a water purification plant without daily laboratory control tests, but experience has shown that many plants are so operated. An occasional bacteriological analysis of a water supply, whether monthly or weekly, has little significance. It merely shows the condition of the water at the time the sample was taken. The splendid work of the Sanitary Division of the Minnesota State Board of Health is tending to raise the standard of water purification plants in Minnesota and to demonstrate that the saving of human lives rather than dollars is the high ideal we should have constantly before us.

Short Courses at Universities for Water Works Men.

Texas has set an example to other states by organizing a short course for water works superintendents and purification plant operators at the University of Texas. The local sections of the American Water Works Association can do no greater good for their communities than by stimulating interest in the organization of similar courses of instruction in their state universities and then urging the water works men to attend these courses. The farmers, long ago, realized the value of short courses at the state university and now attend them annually. Why can not the universities do for the water works men what they have done for the farmer? The possibilities for education in this new field are unlimited.

Simple Tests for Small Plants.

Many small water purification plants are unable to pay the salary of a competent analyst. Such plants no doubt have some employe who could learn to perform some of the more simple routine tests, such as turbidity, color, alkalinity and free chlorine, provided that the necessary chemical solutions are prepared for him. The bacteriological tests are somewhat more difficult, but even these can be performed by such an employe if he shows an aptitude for the work and provided that the necessary media can be furnished. A competent water purification expert could, no doubt, be employed by a number of such plants at a comparatively small expense to train the operator, interpret the laboratory results thus obtained, furnish the necessary chemical solutions and bacteriological media, supervise the general operation of the plant and visit the plant periodically. Such an arrangement obtains in some sections of the United States and has been found to work very satisfactorily.

A water purification plant that is operated without laboratory control is merely furnishing a false sense of security to the community. The same plant, when operated under laboratory control and competent supervision, can and should yield a safe and pure water at all times.

The foregoing paper by Mr. Birdsall was presented at the Rochester meeting of the Minnesota section of the American Water Works Association in December, 1919.

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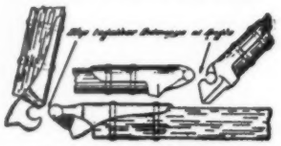

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DATA ON SIX 1920 HIGHWAY CONTRACT LETTINGS IN NEW YORK

The accompanying tables give in convenient and condensed form information regarding the first six 1920 contract lettings of the New York State Highway Commission. They show the amount of work advertised, the number of bids received, the average cost per mile for each type as estimated by the Commission, and the actual average cost as shown by the low bids.

As the Commission distributed a circular under date of Dec. 31, 1919, giving estimates of costs on different pavement types, these estimates are also shown upon the tables for ready comparison with the actual costs.

NEW YORK STATE—LETTING OF JAN. 30, 1920

Projects 1529, 1538, 1539, 1540, 1419, 1533, 1228-A, 1542, 1389, 1388, 1545, 1546, 1467, 1526, 451-A, 1321-A, 1452, 1352, 1480, 1537, 773-A.

Completion Contracts

	Cement Concrete	Bituminous Macadam	Water Bound Macadam
Number of projects	15	4	2
Mileage	56.63	26.18	15.11
Bids received—No. of projects	7	3	2
Bids received—Percentage of mileage	26%	80%	100%
Av. Engineer's estimates per mile complete	$32,929	$18,277	$15,963
Av. low bid price per mile, complete.	37,969	14,820	15,614
Average estimates for surface published by Comm. 12/31/1919....Light —	24,363.76	22,155.56	
Heavy—	28,544.12	28,599.61	

NEW YORK STATE—LETTINGS OF MARCH 18, 1920

Projects 1533, 1532, 1438, 1542, 1389, 1547, 1548, 1383, 1545 1546, 1520, 1553, 1554, 1551, 1555, 1549, 1550, 5655, 1429, 1552, 1471.

Completion Contracts

	Cement Concrete	Bituminous Macadam	Water Bound Macadam
Number of projects	14	6	1
Mileage	62.61	26.28	6.96
Bids received—No. of projects	8	6	None
Bids received—Percentage of mileage	62%	100%	.....
Av. Engineer's estimate per mile, complete	$35,556	$27,114	$29,368
Av. low bid price per mile, complete.	31,596	26,367	.....
Average estimates for surface published by Comm. 12/31/1919....Light —	24,363.76	22,155.56	
Heavy—	28,544.12	28,599.61	

NEW YORK STATE—LETTINGS OF APRIL 16, 1920

Projects 1529, 1530, 1385, 1442, 1449, 1358, 1359, 1556, 5653, 1557, 1321, 1550, 5657, 1471 (No. 1559, consisting of two types, omitted)

Construction Contracts

	Cement Concrete	Bituminous Macadam	Water Bound Macadam
Number of projects	9	4	1
Total mileage	25.67	13.05	8.34
Bids received—No. of projects	4	1	1
Bids received—Percentage of mileage	39%	18%	100%
Av. Engineer's estimate per mile, complete	$39,205	$27,851	$29,034
Av. low bid price per mile, complete.	41,430	32,712	28,481
Average estimates for surface published by Comm. 12/31/1919....Light —	24,363.76	22,155.56	
Heavy—	28,544.12	28,599.61	

The tables show that New York State is paying $13,000 per mile more for cement concrete than for bituminous macadam, that the percentage of mileage of bituminous macadam upon which bids have been received is almost double that for cement concrete, and that the actual relative costs of these two types is very different from that shown by the Commission's estimates of last December.

In comparing these costs and estimates it should be noted that some of the concrete is reinforced and some is not and that some has an average thickness of 5½ ins. and some 6½ ins. The thinner is believed to predominate.

NEW YORK STATE—LETTINGS OF APRIL 16, 1920

Projects 1245, 1247, 1248, 1249, 1232, 1234, 1235, 1241, 1242, 1240, 1244, 1250, 1251, 1233, 1239, 1237, 1238, 1243.

Repair Contracts

	Cement Concrete	Bituminous Macadam	Bituminous Concrete	Heavy Bit. Surface Treatment
No of projects	14	1	1	2
Total mileage	39.73	3.00	4.33	4.41
Bids received—No. of projects	10	1	1	2
Bids received—Percentage of mileage	65%	100%	100%	100%
Av. Engineer's estimate per mile, complete	$31,764	$14,663	$19,010	$6,268
Av. low bid price per mile, complete	30,377	14,263	18,863	5,880
Av. estimates for surface published by Comm. 12/31/1919 ...Light —	24,363.76	22,155.56		
Heavy—	28,544.12	28,599.61	32,554.89	

NEW YORK STATE—LETTINGS OF MAY 5, 1920

Projects 5645, 1533, 5639, 1482, 1515, 5641, 5659, 1467, 5654, 1552, 1561.

Construction Contracts

	Cement Concrete	Bituminous Macadam
Number of projects	9	2
Total mileage	31.08	8.70
Bids received—No. of projects	Withdrawn by Comm.	
Av. Engineer's estimate per mile, complete	$40,210	$33,945
Average estimates for surface published by Comm. 12/31/1919 ...Light —	24,363.76	22,155.56
Heavy—	28,544.12	28,599.61

NEW YORK STATE—LETTINGS OF MAY 5, 1920

Contract Nos. 1254, 1253, 1246, 1255, 1236, 1264, 1256, 1262, 1263, 1252, 1258, 1259, (No. 1257—two type project omitted)

Repair Contracts

	Cement Concrete	Bituminous Macadam	Bituminous Slag	Light Bituminous Surface Treatment
No. of projects	9	1	1	1
Mileage	22.39	2.69	2.31	45.42
Bids received—No. of projects	6	1	1	1
Bids rec'd.—Percentage of mileage	67%	100%	100%	100%
Av. Engineer's estimate per mile, complete	$25,510	$15,625	$19,061	$694
Av. estimates for surface published by Comm. 12/31/1919 .. Light —	24,363.76	22,155.56		
Heavy—	28,544.12	28,599.61		

SUMMARY OF SIX 1920 NEW YORK STATE HIGHWAY LETTINGS OF JAN. 30, MAR. 18, APR. 16, MAY 5, JUNE 7 and JULY 2 ON COMPLETION, CONSTRUCTION AND REPAIR CONTRACTS

	Cement Concrete	Bituminous Macadam	Bituminous Concrete	Waterbound Macadam	Light Bit. Surf. Treat.	Misc.
No. of projects advertised	90	22	1	4	2	9
Mileage	280.43	92.90	4.33	30.41	127.54	21.21
Bids received—No. of projects	48	15	1	3	2	....
Bids received—Percentage of mileage	47%	72%	100%	77%	100%	....
Av. Engineer's estimate per mile for 1920 projects, complete	$34,849.00	$24,222.00	$19,010.00	$22,613.00	$615.00	....
Av. Low Bid price per mile, complete for lettings of Jan. 30, Mar. 18, Apr. 16, June 7 and July 2	$33,961.00	$20,876.00	$18,863.00	$20,105.00	$551.00	....
Average estimates for surface alone published by Commission, Dec. 31, 1919....Light —$24,363.76		Light —$22,155.56	.....	.....	.....	....
Heavy—$28,544.12		Heavy—$28,599.61	$32,544.89	.....	.....	....

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., October, 1920.

NEW YORK STATE—LETTING OF JUNE 7, 1920

Contract Nos. 1269, 1260, 1271, 1272, 1270, 1275, 1274, 1280, 1253, 1261 1246, 1277, 1273, 1257, 1235, 1281, 1279, 1276, 1258.

Repair Contracts

	Cement Concrete	Bituminous Macadam	Asphalt Block & R. C. Concrete & Bit. Macadam	Willite	Light Surface Treatment
Number of projects	13	2	2	1	1
Mileage	29.66	6.97	4.87	1.04	82.12
Bids Received—No. of projects	9	1	2	1	1
Bids Received—Percentage of mileage	72%	58%	100%	100%	100%
Av. Engineer's Estimate per mile, complete	$36,418	$20,642	$41,616	$22,428	$571
Av. low bid per mile, complete	34,641	19,708	40,815	22,422	551
Average Estimates for surface published by Comm 12/31/1919 — Light	24,363.76	22,155.56			
Heavy	28,544.12	28,599.61			

NEW YORK STATE—LETTING OF JULY 2, 1920

Contract Nos. 1282, 1269, 1260, 1268, 1274, 1208, 1261, 1277, 1225, 1248.

Repair Contracts

	Cement Concrete	Bituminous Macadam	Misc.
No. of projects	7	2	1
Mileage	12.66	6.03	1.50
Bids Received—No. of projects	4	2	0
Bids Rec'd.—Percentage of mileage	52%	100%	
Av. Engineer's Estimate per mile, complete	$40,472	$28,274	$51,820
Av. Low Bid price, per mile, complete	39,826	27,500	
Av. Estimates for surface published by Comm. 12/31/1919...Light —	24,363.76	22,155.56	
Heavy—	28,544.12	28,599.61	

While the specifications for cement concrete during the early part of 1919 customarily called for 1 part of cement to 4½ parts of sand and stone, the practice adopted later in the year which applies on the 1920 work provides for a leaner mixture calling for 1 part of cement to 6 of sand and stone.

The minimum bituminous macadam was announced by the Commission's circular to be 11 ins. in thickness but it is stated that Division Engineers received instructions early in the year to increase this to 15 ins.

Of the total mileage for which bids have been received at these six lettings, 116 miles are completion contracts and less than 21 miles new construction. The balance are repair contracts.

The tables were compiled from the regularly issued notices and tabulations of the Contractor's Service Office at Albany.

UNIT COSTS ON NORTH CAROLINA HIGHWAYS

The following information with respect to current prices of road construction in North Carolina was released on Sept. 7, 1920, by the North Carolina State Highway Commission. The figures quoted are the prices at which contracts have recently been let in that state:

Clearing and Grubbing, per acre	$75.00	$150.00	$200.00
Common Excavation, cu. yd.	.54½	.58	.55
Borrow Excavation, cu. yd.	.54½	.58	.58
Solid Rock Excavation, cu. yd.	1.90	2.25	
Top Soil Surfacing, cu. yd.	.75	.72	.70
15-in. Terra Cotta Pipe, lin. ft.		2.10	2.00
18-in. Terra Cotta Pipe, lin. ft.	2.00	2.75	3.00
20-in. Terra Cotta Pipe, lin. ft.			
24-in. Terra Cotta Pipe, lin. ft.	3.00	4.00	4.00
15-in. Corrugated Pipe			3.50
18-in. Corrugated Pipe			4.00
Concrete Headwalls, Class B, cu. yd.	35.00	30.00	30.00
One Course Gravel Surfacing, cu. yd.	2.00		
Overhaul	.01	.04	.04
Concrete Structures, Class A	35.00		
Reinforcement Steel	.11		
Bolts and Plates	.11		

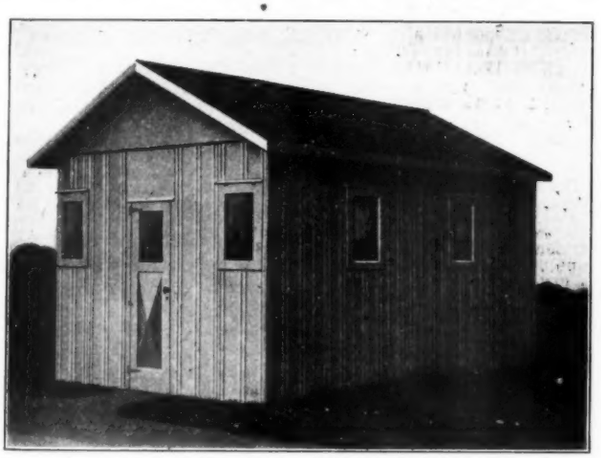
PATENT APPLIED FOR ON IMPROVEMENT TO AUSTIN CUBE MIXER DRUM

Application has been made to the U. S. patent office for an improvement on the Austin Cube Mixer drum. Strong claims are made on speed of mixing, loading and discharge. The new design is called the Cube-Hex and the mixing action is increased by the addition of six extra planes which throw the concrete across that thrown by the six side planes. The claims are that dry mix, specified by many states, is much more quickly mixed than even by the cube shaped mixers used by the U. S. government at Panama Canal Locks.

BUILDINGS FOR VOTING PURPOSES

Owing to the shortage of housing facilities, and other sundry causes, it has been found difficult in many localities to provide suitable buildings for election purposes.

The solution of this oft-times perplexing problem has been found in a standardized, portable steel building recently placed on the market by a large steel building manufacturer. The advantageous feature of this building is its portability—its standardized design permits quick dismantling with ordinary labor and transportation to another locality in either a wagon or truck. This feature is especially desirable because of changing voting places in different precincts.



QUIXET VOTING PLACE.

This building is made of steel throughout; the structural framework, the galvanized sidings, steel window frames and sashes, and kalameined doors, give rigid and durable construction which means almost the entire elimination of maintenance expense. When not in use as voting places, these buildings could serve to provide storage facilities for county road building equipment.

The Blaw-Knox Company of Pittsburgh, in placing this building on the market, has opened the way to a considerable ultimate saving in building costs and rentals which is well worth some thought.

Champion Snow Plow attached to a Sauer Truck. Used by the City of Brooklyn, N. Y.

Quick and Easy Snow Removal

There are no traffic tie-ups or periods of suspended business through snow falls, in the town, city or state, adequately equipped with Champion Snow Plows.

Easily and quickly attached to any standard motor truck, Champion Snow Plows offer a modern, economical and never-failing method of snow removal under all conditions. When not in use they can be removed from the trucks which are then available for other uses.

Write or wire for Bulletin K. D. T. containing detailed information and interesting photographs.

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"Everything for the Roadmaker"

P & H Excavator-Crane Excavating a Road Ditch and Grading the Road

Road Builders' Combination Machine for Excavating, Grading, Backfilling and Material Handling

The P & H Excavator-Crane is capable of performing the four general functions of Excavating, Grading, Backfilling and Material Handling. The four major uses of this equipment by road builders are as follows:

Grading Roads. Where roadbeds are low and need "shouldering up," or where fill must be made through water-logged and swampy land, the P & H Excavator-Crane will pull in and heap up the ground much faster and cheaper than will teams and graders.

Making Cuts. The P & H will make cuts in roads at the rate of 300 to 500 yds. per day. The average cost seldom exceeds $20 for a day's operation. When the excavated material is loaded in wagons, the capacity is reduced only about 10 per cent. For constructing drainage ditches the P & H is run alongside or center of the completed road, excavating the ditches to the required depth and wasting the dirt on the slope of the roadbed or beyond the ditch. On this operation the machine cost is rarely over 8 cts. per yard, even when handling wet earth where it is often impossible to work teams.

Excavating Gravel. Capacity (approximate) 300 to 500 yds. per day of gravel from the bank into trucks and wagons. The hauling equipment, working with a P & H, is never in the excavated hole as it is with steam shovel or trap loading. The P & H Excavator-Crane has a full circle, non-obstructed swing with an operating radius of 30 ft.

A Complete Portable Locomotive Crane. Equipped with a hook, magnet or other grappling device, the P & H is a complete portable locomotive crane with a lifting capacity of 3,500 lbs. at 30-ft. radius. Great for cleaning up a yard, placing pipe in trenches, pulling piles, moving the bulky stuff, loading and unloading cars.

Condensed Specifications

Length of Boom—30 ft.
Size of Buckets—½ yd. drag, scraper clamshell, orange peel.
Width—8 ft. 4½ ins.
Length—19 ft. 9¾ ins.
Weight—14 tons.
Traction Speed—1 mile per hour.
Power—4 cylinder, 5x6¼ ins., 40 h.p., gasoline or distillate.
Tubular Type Radiator—Latest heavy truck design.
Dragline Pull—9500 lbs. Speed—100 ft. per minute.

LIFTING CAPACITIES:

Radius in ft.	Weight
8	15,200
12	9,800
16	6,900
20	5,200
25	3,900
30	3,300

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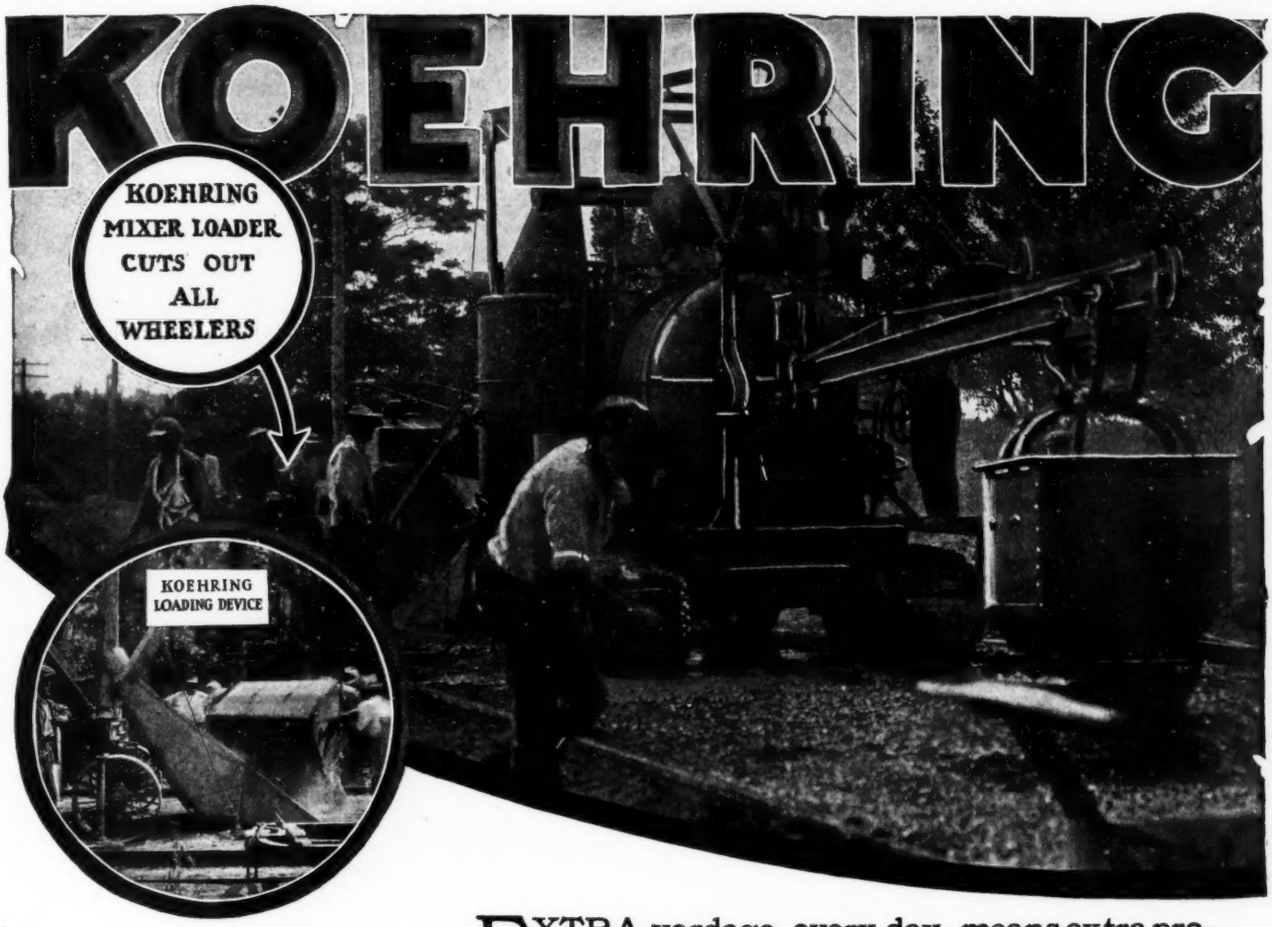
P&H — excavators — back-fillers - tampers

KOEHRING

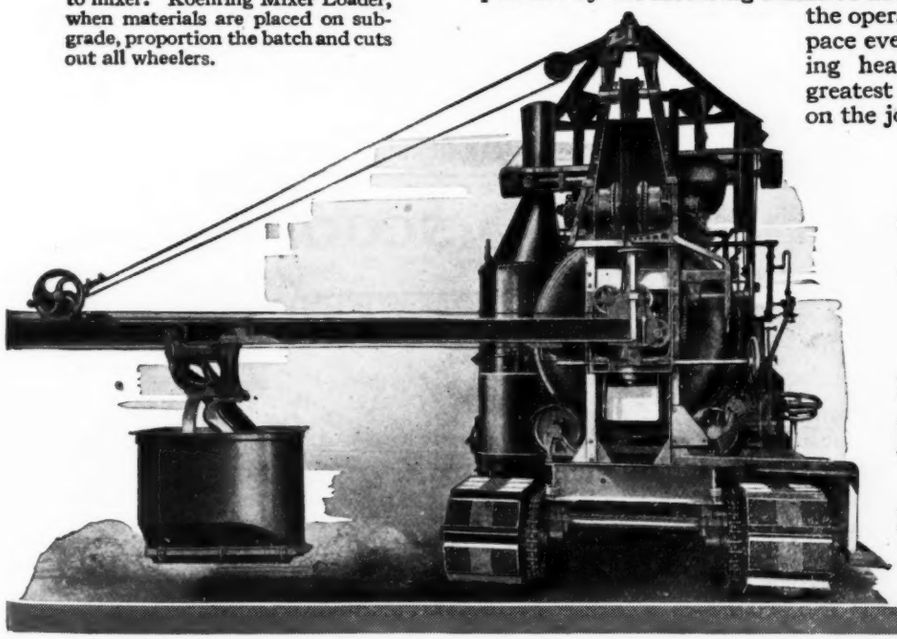


Koehring loading derrick part of Koehring mixer equipment when batches are made up at central loading station and brought to mixer in batch boxes on industrial cars and trucks.

Long narrow design of Koehring Pavers gives extra room on subgrade to bring industrial car close to mixer. Koehring Mixer Loader, when materials are placed on subgrade, proportion the batch and cuts out all wheelers.

EXTRA yardage, every day, means extra profit—because the Koehring is the fastest paving unit—the mixer of liberal drum dimensions, fast loading and discharging, and with Koehring boom and bucket, the fastest distributor of any consistency of concrete.

It's the fastest paving **unit** because these fast operations are made possible by the Koehring exclusive automatic actions which enable the operator to keep up the high speed pace every minute of the day. Koehring heavy duty construction is the greatest profit-insurance you can put on the job.



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Construction Mixers: 4, 7, 10, 14, 21, 28, Steam and Gasoline.

Paving Mixers: 10, 14, 21, 28. Boom and Bucket and spout distribution, caterpillar traction, loading derrick, steam and gasoline.

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THE SUB-GRADE AND ITS RELATION TO ROAD SURFACING AND TRAFFIC

The Federal Highway Council Committee on Sub-Grade and its Relation to Road Surfacing and Traffic presented the following preliminary report at the conference meeting of the various committees of the Council, held at Akron, Ohio, on Sept. 27 and 28, 1920:

The conditions of traffic have undergone a very radical change during the past several years. We have seen the weight of the individual unit of traffic gradually increase so that at the present time, many of our roads are forced to carry motor trucks having a capacity of 7½ tons. As a result the wheel concentrations on the road surface combined with lack of supporting value of the underlying subgrade have resulted in structural failures of every type of road constructed up to the present time.

Eliminating Road Failures Due to Poor Foundations

The problem of eliminating road failures due to poor foundations seems to be possible of solution in one of the following ways:

1. Make the road surface thick enough so that the pressure from heavy traffic will be sufficiently distributed to the underlying subgrade, or so that the surface because of its inertia may absorb a considerable amount of the shock of traffic.
2. Design the slab to have sufficient strength to bridge over the soft subgrade.
3. Improve our drainage systems to exclude moisture in sufficient amounts from soils which are rendered of very low bearing value by the presence of moisture.

It is perhaps true that most soils have adequate bearing value when they have a sufficient low percentage of moisture or it is not impossible that some soils will be susceptible of treatment, either chemically or mechanically, which will render them of a higher bearing value than they have in their natural condition.

Knowledge as to how to treat types of soils so as to stabilize them and render them of the highest value, is at present non-existent, and it is the purpose of this subgrade committee to make such studies as are necessary to throw light on the methods of treatment of subgrades so as to make them of adequate supporting value for the various types of road surfaces.

Your committee feels that the most important problem from the standpoint of road design at the present time is that of determining means for increasing the supporting value of the subgrade.

We feel that a very intensive study must be made to discover, first, the underlying cause of weak subgrades and, secondly, discover means for correcting poor subgrade conditions.

The field to be covered by this committee is exceedingly large and to accomplish the desired results in the shortest possible time, it is necessary to sub-divide our committee into a number of problem committees, each problem committee to study a particular phase of the subject.

Problems to Be Studied

The following problems have been outlined as subjects to be studied by the various committees:

Problem 1—(a) Obtain samples of subgrade material at points where failures have occurred; also obtain samples from the same road of like construction and like traffic where failures have not occurred. Data accompanying the samples should contain information as to the typography, type of drainage, character of construction, and all other information having relation to the condition of the road.

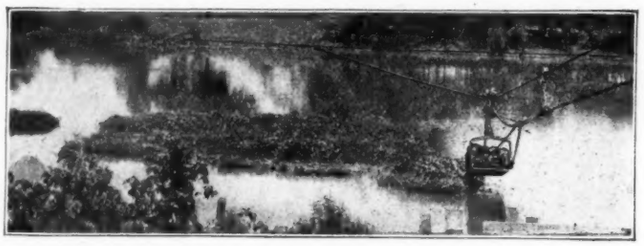
(b) Make physical examination, bearing value tests and such other investigations as may be suggested with data furnished.

Problem 2—Developing Field Tests for Bearing Power of Soils.

Problem 3—Making Studies in Drainage, using experimental sections of roads.

Problem 4—A study of Chemical Methods of Sub-

MATERIAL-HANDLING SIMPLIFIED



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The ability of the Sauerman Dragline Cableway Excavator to dig from either above or below water, and to elevate and convey materials from pit to plant without the help of auxiliary machinery, is the reason for its popularity among sand and gravel producers. This same ability makes our type of equipment correspondingly economical and efficient for a wide variety of other material-handling operations, and it is now being successfully used for cleaning reservoirs, building levees, rehandling coal, deepening rivers, reclaiming material from stock piles, loading ballast, etc., etc.

For further information send for our catalog, or lay the details of your problem before us and we will submit our recommendations on equipment.

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Problem 7—A Study of the Effect of Moisture on the Volume Changes in Soils.

Problem 8—A Study of the Transmission of Pressure Transmitted to the Subgrade.

Problem 9—A Study to Ascertain the Practical Classifications of Subgrade Materials.

Problem 10—Special Problems.

In order to expedite the work of the various committees handling these problems, a tentative outline of procedure has been drawn up which will serve as a guide to the sub-committees and enable them to decide in the shortest possible time, on the methods of procedure to be followed by them in their studies.

The various sub-committees are expected to report their proposed procedure to the special advisory committee not later than November 15th and after this date, the sub-committees should be able actively to pursue their various investigations.

There is every indication that the amount of traffic over our roads will be greatly increased in the future and this probably applies particularly to the transportation of freight.

The expenditures involved in the construction of the various road systems is enormous, and it is vital that these roads be built on foundations as stable as it is possible to make them.

It has been pointed out that the subject with which this sub-committee is to deal has many ramifications and it has likewise been pointed out, that it is exceedingly important that we obtain results in the shortest possible time.

An investigation of methods for obtaining high-class construction should very properly be considered as part of any program of construction and it should be emphasized that of the funds appropriated for road construction, there should be set aside an adequate portion for pursuing the needed investigations to make for wise expenditure of these funds.

The importance to all for the hopeful outcome of this work by which our roads should be built more economically and more durably, deserve and should receive every support, especially the undivided support of all commercial interests as they are wrapped up in the superior advantages to them of the early improvement of highways by and through which transportation facilities are increased to a very great extent.

Committee Roster

Chas. M. Upham, Vice Chairman; H. G. Shirley, Secretary; A. T. Goldbeck, Ira B. Mullis, Prof. F. H. Eno, Edward Bridges, D. S. Humphrey, W. P. Blair, Prof. Duff A. Abrams and H. W. Alden.

TELEPHONE STATISTICS SHOW BUSINESS DEVELOPMENT IN SOUTH AMERICA

Srtiking figures showing the development of the South and Central American Republics are made public as a result of a survey by the American Telephone and Telegraph Company. These statistics, which were prepared with the co-operation of the various governments, cover the telephone and telegraph systems of all the countries south of the Rio Grande. The figures are serviceable as indices to the general state of development and of commercial progress in the various American countries and should therefore prove of value to all interested in those countries.

Some of the conclusions reached from this survey are that in the Southern countries the telephone is far from being the universal means of communication that it is in this country and that the main development there is in the big cities, the other areas being very poorly served. The telephone network is about a hundred times as dense in this country, as a whole, as it is there. In point of the number of telephones per hundred of population, the service here is over thirty times as good.

Some of the important points on which latest data are compiled for each of the countries are: Number of telephones and number per hundred of population; mileage of telephone wires; telephone development of the largest city in each country; investment in the systems; gross earnings and unit earnings; telegraph wire mileage, number of offices and number of messages, etc.

The total of 325,403 telephones in all the South and Central American countries, including Cuba and Haiti, should be compared with the 12,000,000 in the United States, which have about the same total population. Argentine leads with 105,205 telephones, or nearly a third of the total. The other countries having more than 10,000 telephones are: Brazil, 67,366; Mexico, 40,211; Cuba, 28,152; Chile, 23,670, and Urugary, 19,486. Haiti, with a total of 2,500,000 people, has 82 telephones.

Only one telephone for about every 300 population is found in the whole area, as compared with 11.39 for every 100 of population in the United States at the same date, or about 34 for every 300 population. Uruguay leads the Latin-American countries in point of telephone density with 1.34 telephones per 100 people. The only other countries having as much as 1 telephone per 100 population are Argentine, Cuba and Panama. In the three countries having the highest telephone development, the systems are almost wholly under private ownership.

The total telephone wire mileage is 905,587, compared with 29,800,000 in this country. Taking into consideration the fact that the total area of the South and Central American countries is 8,476,600 square miles compared with the 3,027,000 square miles of the United States, there is only one-tenth of a mile of wire for every square mile in the Latin countries, while there are nearly ten miles for every square mile here. This means that the telephone network is nearly a hundred times as highly developed here as down there.

The extent to which the countries are served by their systems is indicated by the figures showing the telephone development in the largest city in each country. Habana, Cuba, is the most highly developed, with 5.5 telephones per 100 population. Taking in all of Cuba, however, there is only 1 telephone per 100 people. Mexico City has 3.9 per 100; Mexico as a whole has only 0.25 telephones per 100 population. These figures show how in the Southern countries the bulk of the systems are in the large cities, while the other areas are hardly served at

all. This condition is contrasted with that in the United States. At the same date New York City had 11.7 telephones per 100 people—the United States as a whole had nearly as many, 11.39. Here is adequate service for even the smallest farm communities.

The investment in telephone systems in all the Southern countries together is $64,422,000 compared with $1,600,000,000 in the United States. The per capita investment is 71 cts. in South America compared with $15.09 here. The highest investment is in Cuba, $2.28 per capita. The investment per telephone is perhaps even more significant. In Latin-America there is invested $198 for every telephone in service—in the United States this is only $132. These figures reflect the higher technical progress and the more efficient management, as well as the greater density of development, in this country.

The gross earnings in 1918 of South American telephone systems were only 18 cts. per capita while in this country they were $3.99. The gross earnings per telephone were, however, $52.82 down there and only $34.98 here.

Of the total telephone and telegraph earnings in 1918 in the Latin countries, the telephones brought in only 43.5 per cent. of the total and the telegraph 56.5 per cent. In the United States this situation is strikingly reversed—80.8 per cent. from telephones and 19.2 per cent. from telegraphs. The total telegraph wire mileage is 433,938 down there and 1,900,000 here. The number of offices are 11,627 and 28,900 respectively. The number of messages sent in 1918 was 41,517,200 in the Southern countries as compared with 170,000,000 here.

The telegraph statistics therefore show a more favorable comparison with those of this country than do the telephone figures. The reason is that the telegraph is used more by a specialized class of the population mainly for business. The telephone has not in the Latin-American republics come anywhere near being the universal and democratic means of communication that it is in the United States.

CENTRALIZATION AND INTERCONNECTION OF ELECTRIC POWER PLANTS

By A. L. Mullergren, With Johnson & Benham, Consulting Engineers, Firestone Bldg., Kansas City, Mo.

The ultimate solution of efficient power production in this country is the construction of huge electric power plants at the centers of our natural fuel reservoirs and transmitting the power to the markets by electric transmission lines. It is far more economical to transmit large blocks of power from large efficient power plants to the industrial centers than to transport the fuel by rail to the market centers. There are at present in the United States approximately 6,500 electric power stations having a total rating of 13 million horsepower. Of this amount there is approximately 4½ million horsepower developed from water power. The balance is represented by steam and internal combustion engine plants. A large percentage of the above number of establishments consists of plants of less than 1,000-h.p. capacity.

Some Interconnections Made During the War

During the recent emergency there was quite an advance made in the efficient production of power by the interconnection of existing power plants in order to be able to handle the increased power requirements of the country and to conserve our fuel resources. The few interconnections that were made demonstrated very thoroughly the feasibility and efficiency of this plan. Some of the leading engineers of the country are now advocating very strongly the construction of transmission lines to interconnect more of the present power plants where such interconnections appear economical, and others are urging the construction immediately of mammoth plants at our fuel centers and interconnecting them by transmission lines. The plants that are being advocated would be super-plants having a capacity of from 150,000 to 250,000 k. w.

Considerable study has been made of the most economical transmission voltage for interconnection purposes and a recent paper presented to the American Institute of Electrical Engineers brought out the fact that 220,000 volts would be the most feasible and economical and such a system could be constructed without any material change in the design of present transmission line material. The highest transmission voltage in use at present is 150,000 and serves a 240-mile transmission system in California. This line is capable of transmitting approximately 57,000 k. w. with a line loss of 11 per cent. Studies of this line have indicated that it would be feasible to increase the voltage to 220,000 at a relatively small expense. By the increasing of the voltage to 220,000 there can be transmitted 125,000 k. w. with the same line loss above indicated.

Progress and Projects

California has taken the lead in the interconnection of their existing power plants and in utilizing to a very great extent the potential water power resources. In the southeastern portion of the United States considerable development has also been made along this line. A comprehensive scheme for the Northwestern states has been worked out for the erection of huge stations and interconnecting them. The territory served by the proposed project is from Pennsylvania north to Maine and takes into consideration the utilization of all of the existing water power resources in that section and the construction of large steam stations. The Central States are sadly deficient in the economic production of power, as this particular section has a large number of small and isolated stations operating independently.

Advantages of Interconnection

The advantages of interconnection of plants scattered throughout a large territory are apparent. In the first place, the diversity factor is considerably improved by such interconnection. Plants in the different territories serve different kinds of loads and consequently there are certain periods of the day and night that these plants in each territory are considerably under-loaded. By the interconnection of these plants, the hours of peak load of one plant would be the hours of a very low load of another plant, and the two plants operating together would be able to operate at or near their normal rating at a considerable saving in fuel and in the installation of generating equipment. Furthermore, the interconnection of a number of plants insures greater reliability of service. The problem that will come before the engineering profession within a few years will be the construction

of these super-stations at the centers of our fuel reservoirs and the construction of high-tension transmission lines. These super-stations will be scattered throughout the entire country and interconnected by groups or districts. It has been predicted that some day in the distant future we may see an interconnected transmission system extending from Maine to California and from the Great Lakes to the Gulf, all served jointly by a number of plants of large capacity.

Super-Stations in Project

The average small central station of 500-k. w. capacity and less has an efficiency from the coal pile to the switchboard of less than 5 percent. The efficiency of these super-stations will probably average 20 per cent. In fact, the large central stations of today show an efficiency of around 40 per cent. and considerable improvements are being made every day. This indicates that there is considerable room for fuel conservation by the installation of these super-stations. By the construction of the proper transmission lines transmitting large blocks of power, the loss of transmitted energy will average 10 per cent. From studies made of the interconnection problem, the 220,000-volt transmission system appears to be the probable ultimate plan. In the installation of lines of extremely high voltage, there are several factors to be taken into consideration which determine the most economical voltage. The corona loss and charging current of the line are very important factors entering into the operation of high voltage lines and limit the maximum voltage for a given block of power to be transmitted. Studies of this problem indicate that at 220,000 volts the probable block of power to be transmitted per circuit is around 125,000 k.w. In developments of this character reliability of service is of course essential and duplicate lines should therefore be installed, either by parallel lines or by ring or loop system. As the power requirements of the district increase beyond the capacity of the lines, it will of course be feasible to construct additional lines.

Increase in Manufacturing

The number of manufacturing establishments in this country is increasing quite rapidly and it will be necessary to make provision for future increases. In 1914 there were approximately 275,000 manufacturing establishments in the United States. This refers to plants of every nature manufacturing products in excess of $500 per year. The total power represented by the above establishments was 24 million horse power and of the above amount approximately 8 million horse power was in electric motors. This is increasing to a great extent. In fact, during the 5-year period from 1909 to 1914 the capacity of electric motors installed in these plants increased 80 per cent. Motor drive is well recognized as the most economical form of power and the leading industries of the country are realizing this more and more every day and are changing their form of power to electric drive. Therefore, it is necessary that the central station industry take cognizance of this fact and make preparations to take care of the increasing demand that will be made upon it.

Central Plants at Fuel Centers

We will see in the very near future a network of transmission lines emanating from large central stations and extending to all market centers and the small town and the farmer will be able to utilize this efficient form of power at greatly reduced cost. Plans are under way in Oklahoma at present for the construction of two large central stations at the fuel centers and it is very likely that additional super-stations will be constructed in the districts favored by natural fuel resources and the transmission lines extended to other parts of the state not favored by fuels. As all know, the western portion of Oklahoma is considerably handicapped by lack of fuel resources and the extremely high price of fuel in that section, and when such time comes that the high-powered transmission line serves this particular section, it will be able to have its own manufacturing industries.

In conclusion it may be stated that from present indications there will be constructed in the very near future super-stations of from 150,000 to 250,000 k.w. capacity, interconnected by 220,000 transmission lines and territories that are now badly in need of cheap power will be able to benefit by same.

The foregoing article is the major portion of a paper presented by Mr. Mullergren before the latest annual convention of the Oklahoma Society of Engineers.

CONTRACTS AWARDED

ROADS AND STREETS

Ala., Bessemer—J. E. Moran Paving Co., awarded contr. for 66,300 sq. yds. Warrenite-Bitulithic pavement on 5-in. cement concrete foundation.

Ariz., Florence—Maurice Ryan, Francos Aparts., 10th and Broadway, San Diego, awarded contract for constructing Sec. D, Florence-Superior Hwy., F. A. Proj. 23, at $134,111.

Cal., El Centro—Peterson, Dillon & Patterson (H. H. Peterson, Calexico and H. E. Dillon, 3788 S. Vermont Ave., Los Angeles), awarded contract for paving with concrete 28¼ mi. Imperial Co. Hwy., at approx. $774,090. Contr. includes 3 sects. of road—Imperial to Coltville, Brawley to Calipatria and El Centro to Calexico. Grading is being done by county.

Cal., Los Angeles—Rogers Bros. Co. 350 Merrick St., awarded contr. for paving 5.1 miles Alameda St. (Harbor Trk. Blvd.), from Slauson Ave. to Burton Ave., with 8-in. rein. conc. and disintegrated granite shoulders, at $271,946.

Cal., Los Angeles—Geo. H. Oswald, 366 E. 58th St., awarded contract for impvt. of Western Ave., Santa Barbara to Slauson Ave., at $184,904.

Cal., San Diego—Southwest Paving Co., 601 Cit. Nat. Bk. Bldg., Los Angeles, award. contract for paving 5.6 miles San Luis Rey Co. Rd., No. 2. Oceanside to Guaiome, at $152,333.

Cal., Santa Cruz—Bates & Borland, Oakland Savings Bk. Bldg., Oakland, awarded contract for constructing 4.7 miles of road between Santa Cruz and Boulder Crk., at $150,078.

Colo., Colorado Springs—Harold Shuck, Denver, awarded contract for about 3 miles of paving on the Broadmoor stretch from city limits on Nevada Ave. to Broadmoor Hotel, at $126,565.

Ida., Boise—S. E. Cumerford, low bidder on North and South Hwy. proj., Washington Co., at $179,870. Funds available $194,940. Contr. will be let pending approval of Co. Commrs.; J. C. Maguire, low bidder on F. A. Proj. 21, Roosevelt Hwy., Bonneville Co. Funds available $194,676; contractor's bid $243,771. Work will be carried on as far as available funds will permit; Fred Coolidge awarded contr. for construction of 19.2 miles of rd. in Power Co. on Idaho-Pacific hwy., at $108,583, also concrete for Butte Co. project on Idaho Central Hwy. Funds in amt. of $90,000 available for this work.

Kans., Oswego—Watts & Strafford, Concordia, Kans., awarded contr. by Council for 21,000 sq. yds. asph. conc. pavement, at $100,125.

Ky., Barbourville—Davy & Grahams, Pineville, Ky., awarded contr. to grade and drain 11.4 miles of road in Knox Co., at $365,916.

Ky., Dixon—J. L. Towsen, Clay, Ky., awarded contract to grade and drain 11.4 miles Dixon-Madisonville and Henderson roads, Webster Co., at $276,395.

La., Vidalia—Junkin & Gregory awarded contract to constr. 12 mi. gravel rd., Vidalia to Deer Park, at $100,000.

La., Vidalia—Junkins Bros. & Gregory awarded contract to constr. 12 mile road, at $120,000.

Me., Augusta—Following contracts let by State Hwy. Comn.: Paving 3.92 mi. State Rd. bitum. macadam, Westbrook, to A. D. Bridges Sons Co., Inc., Hazardville, Conn., at $92,739; Hassam Paving Co., 17 Federal St., Worcester, Mass., contr. for paving 4.57 mi. State Rd. concrete, Oxford and Norway, at $133,183; graveling 3.31 mi. State Hwy. Houlton, to Greenwood Constr. Co., Skowhegan, at $61,857; 3.6 mi. State Rd., Island Falls and Dyer Brook, to M. Hughes, Bangor, at $70,481; bldg. 2:25 miles conc. road from Norway to Paris Twp., to J. H. Kerr, Rumford, at about $75,000.

Mich., Detroit—Jno. A. Mercier awarded contr. for rd.-bed to be constructed on Charlevoix-Buchanan section of Municipal Ry., at $605,531.

Mich., Lansing—J. A. McKay & Son, De-

troit, awarded contract for grading, draining and surfacing 8.046 mi. Assessment Dist. Rd. 205, 16 ft. wide, St. Clair and Macomb Cos., at $119,388.

Minn., Aitkin—B. Olson, Aitkin, awarded contract for grading and graveling 10 miles F. A. Proj. 86, St. Rd. 3, at about $106,000.

Minn., Walker—P. W. Roark, Thf. River Falls, awarded contract for 12.66 miles Job 2004, and also 12.6 mi. F. A. Proj. 140, State Rd. 11, at $93,787 and $43,700 respectively; 7.59 mi. F. A. Proj. 142, State Rd. 6, to L. & L. Constr. Co., Walker, at $57,089; Wilkinson & Pettijohn, Walker, contr. for grading and graveling 7.5 miles Job 2001, at $44,558.

Mont., Helena—B. P. Melchert, Lewistown, awarded contract for proj. 48, Fed. Hwy.—25 miles rdway betw. Baker and Ekalaka, Fallon Co., at $72,076; J. E. Hilton awarded contr. for No. 86—17 miles and brdg. Fallon Co., on Yellowstone Trail, at $110,646; Albert Carlson, contract for proj. 129, for 1.16 miles on Pershing Crk. Hill in Stillwater Co., at $26,823.

N. J., East Orange—Standard Bitulithic Co. awarded contr. for 19,000 sq. yds. Warrenite-Bitulithic pavement resurfacing Old Telford.

N. J., Newark—Northern Constr. Co. and Marcellus & Osborne awarded contracts for about 58,800 sq. yds. Bitoslag pavement in Belleville and Nutley, N. J. Total cost of contracts, $275,000.

N. J., Trenton—State Hwy. Comn. let contract for paving 22,910 sq. yds. St. Hwy. 1, Milton Ave., Rahway to Rahway-Linden line, bitum. concrete, to M. I. Demarset, Sewaren, at $204,485; 22,382 sq. yds. Sec. 10, Rahway-Linden line to Roselle Boro., bitum. conc., to C. H. Winans, 207 Broad St., Elizabeth, at $214,296; 27,007 sq. yds. Sec. 11, Roselle Boro., to Elizabeth city line, bitum. concrete, to J. Dorer, Irvington, at $237,489.

N. J., Trenton—Weldon Constr. Co., Westfield, awarded contract for paving 9 miles hwy. at Rahway, Union Co., at $115,-850.

N. J., West Orange—Franklin Constr. Co., 52 Vanderbilt Ave., New York City, awarded contr. for impvt. of Mt. Pleasant Ave. here, at $116,700.

N. M., Santa Fe—A. T. Young, Denver, Colo., awarded contract for construction of N. M. Fed. Aid Proj. 34-B, Rio Arriba Co., which includes approx. 12 miles grading and surfacing; also draing. structs. located betw. Chama and Tierra Amarilla, at $95,-991, exclusive of 10% for engineering and contingencies.

N. Y., Long Island City—City let contr. for paving Ash St. to Kennedy & Smith, 94 Main St., Flushing, at $7,898; Broadway, to the Sicilian Asph. Paving Co., 41 Park Row, New York City, at $225,590; Metropolitan Ave., to Welsh Bros., 14 Queens St., Astoria, $13,135; 97th St., to Hastings Paving Co., 25 Broad St., New York City, at $97,680; 97th St., to Cleveland-Trinidad Paving Co., 3409 Kimbull St., Cleveland, at $66,055; Opdyke St., to Pease Bros., 38 Park Row, New York City, at $4,075; Stockholm St., to Union Paving Co., Broadway and 112th St., New York City, at $8,412; crosswalks from Woodside to Stryker Aves., to C. Kurth, $6,576; Grandview Ave., to C. A. Myers, Stagg St., Brooklyn, $10,655.

N. Y., New York—W. J. Fitzgerald, 547 W. 45th St., awarded contract for regulating and repaving W. 54th St., sheet aspht.; also Hudson St., wood block, at $42,758 and $109,131, respectively.

N. C., Carthage—J. T. Plott, Greensboro, N. C., awarded contract to construct 21 miles gravel road in Moore Co., at $150,-000.

N. C., Warrenton—Chandler & Ragland, Virgilina, Va., awarded contr. to construct 19.76 miles clay-gravel road from Warrenton, in Warren Co., at $160,000.

Ohio, Cleveland Heights (Warrensville, P. O.)—Spence Bros., Woodhill Rd., Cleveland, awarded contracts by Village for grading, draining, curbing and paving with asph. Wood Rd.—Crest Rd. to Crest Dr.—Maple Rd.—Mayfield to Wood Rd.; Glenwood Ave.—Cleveland Heights Blvd. to Noble Road, at $45,862, $62,086 and $28,910, respectively.

Ohio, Cleveland Heights (Warrensville, P. O.)—Village let contracts to Cleveland Trinidad Paving Co., The Arcade, Cleveland, for grading, draining, curbing and paving Kensington Rd., at $46,756; Kerrwood Rd., $9,773; Maplewood Ave., $19,949; Oakdale Rd., $19,969; Princeton Rd., $45,-903; Taylor Rd., $47,500; Briarwood Rd., $19,965; Canterbury Rd., $46,385; Colchester Rd., $13,610; Cottagegrove Rd., $19,969; E. Derbyshire Rd., $30,449; Edgewood Rd., $15,231.

Okla., Tulsa—Tibbets & Pleasant awarded contract to pave Riverside Drive addn., $250,000.

Pa., Harrisburg—Contracts for St. Rd. awarded as follows: Delaware Co. Upper Darby Twp. and Milburn Boro., 2,635 ft., to C. E. Wood, Inc., Albany, N. Y., at $36,-084; Northampton Co., Bangor Boro., 7,441 ft., to C. E. Weed, at $110,673; Westmoreland Co., Derry Twp., 13,625 ft., to M. Bennett & Son, Indiana, at $190,931.

S. C., Columbia—Bitulithic Company awarded contract for paving N. Main St., approx. 7 blocks, at $104,824.

S. C., Columbia—Powell Paving & Contg. Co. awarded contract by Richland Co. Hwy. Comn. to construct 15.2 miles Two Notch Rd., 43,265 cu. yds. sand-clay surfacing, at $137,000.

S. D., Aberdeen—St. Hwy. Comn. let contract for grading and draining 21.1 mi. Yellowstone Trail from James west through Aberdeen to west county line, F. A. Proj. 42, Brown Co., to H. C. Hansen, Groton, at $114,696; 10.7 miles Yellowstone Trail—Summit to W. Co. line, F. A. Proj. 44, Roberts Co., also 16.5 mi. rd. west and so. of Leola, F. A. Proj. 63, McPherson Co., to Stevens Bros., St. Paul, Minn., at $74,450 and $91,436, respectively.

Tenn., Memphis—Crinkley Constr. Co., Harriman, Tenn., awarded contrs. for constructing three streets in city (29,545 sq. yds. sheet asph. pavement), at approx. $152,000.

Tex., Cleburne—O'Connor & Gilkison, Dallas, Tex.; also Williams, Burk & Co., Jacksonville, Tex., awarded contracts to construct 16 mi. Lone Willow and Rio Cista Rds., Precinct 1, at $97,000.

Tex., Hillsboro—Bibbs & Hughes, Waco, Tex., awarded contract to construct 75 mi. of road in Abbott, Acquilla, Mt. Calm, Bynum and Hubbard Dists.; $700,000.

Tex., Texarkana—Taylor & Hamilton, Chicago, Ill., awarded contract to pave 60,-000 sq. yds. streets; $300,000 available.

Wn., Colfax—Highway Constr. Co., Colfax, awarded contracts for road bldg. as follows: Impvt. No. 7, from Seltice to Farmington and impvt. No. 8 from Tekoa to near Seltice; crushed rock macadam, at $123,836 and $70,904, respectively.

Wn., Seattle—Jahn & Bressi awarded contract for paving W. 56th St., at $113,-102; S. A. Moceri, contract for paving 17th Ave., et al., at $116,003.

W. Va., Beckley—Sutton Constr. Co., Pikesville, Ky., awarded contr. to construct 4¼ miles Jarrold's Valley Colcord Rd., Marsh Fork Dist., at $115,379.

W. Va., Charleston—Randish Constr. Co., Princeton, awarded contr. to build 4 mi. road from Paint Crk. Jct. to Livingston Sec. 8, at $64,000; 7.1 mi. rd. from Cabin Crk. Jct. to Loudon Dist., Sects. 5 and 6, to Towles & Co., Princeton, at $179,530; 3 mi. rd. from Montgomery west, Sec. 4, to Abbott Bros., Charleston, at $27,470.

W. Va., Fayetteville—J. M. Randish Constr. Co., awarded contr. to grade 9½ mi. road on Lower Loup Crk. from Robson to Ingram Branch, at $134,000.

W. Va., Webster Springs—H. H. Bruffey awarded contract to grade road and constr. culverts; 80,000 yds. excav., $100,-000 available.

SEWERAGE AND SEWAGE TREATMENT

Ariz., Miami—Wm. D. Walsh, 1235 Dewey Ave., Los Angeles, awarded contract for constr. of Sec. 1, Miami Sewer System. Contr. awarded on cement pipe and amounts to about $113,300.

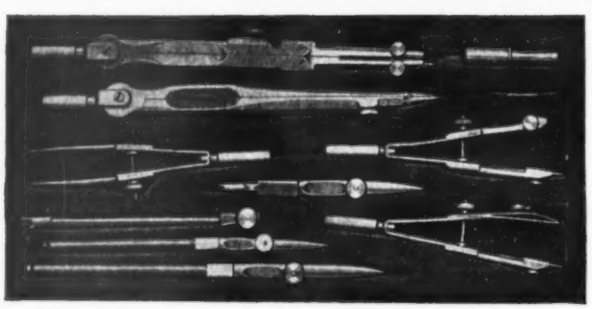
Ill., East St. Louis—J. Keeley Constr. Co. Cahokia Bldg., awarded contract for bldg. 7 miles 48-78 in. rein. conc. and 20-48 in. vitr. sewer pipe in Winstonly Sewer Dist., at about $415,000.

Ind., Muncie—C. C. Harris, Youngstown, awarded contract for constr. of Southside sewer, at $355,000.

Mass., Boston—Jas. Barletta awarded contract for sewerage works in Saville St. and Wren St., betw. Park St. and Oriole St. and Bd. of Survey St. 664, betw. Wren and Emmons Road, W. Roxbury, at $40,-961.

Mass., Boston—D. Vitiello award. contr. for sewerage work at River St., at $4,261; V. Grande award. contr. for bldg. sewerage works, catch basins, manholes, minor drains and surf. drains in Boston at $7,700; Louis Martinello contr. for sewerage wks. in Larch St., Brayton Rd., S. Crescent circuit, private land, Brighton, at $18,950; F. Drinkwater contr. for sewerage works in South St., Lesher St. and private land, Archdale Rd., West Roxbury, at $21,945.

Mass., West Springfield (Springfield, P. O.)—C. D. Farnsworth Co., 16 Union St., awarded contract for bldg. sewerage system in So. Union and Palmer streets, at about $51,000.



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Md., Baltimore—Robertson Bros., 106 Hopkins Pl., awarded contract by Bd. of Awards, for bldg. hydrolytic tank and appurts.; also sludge digestion tank, pipe lines and appurts. at Sewage Disp. Wks., west shore Back River, Baltimore Co., at about $165,460.

Mich., Detroit—City lets contracts to H. Haynes, 70 Davenport St., for furnishing labor and material for bldg. Lat. sewer 3302, at $4,350; to N. Mancini, 580 Concord Ave.; 3307, $11,100; 3324, $29,000; to Lennane Bros., 809 Union Trust Bldg.; 3309, $23,029; 3322, $26,970; to Oakwood Constr. Co., 165 Fort Blvd.; 3311, $11,770; 3312, $8,180; 3323, $43,500; 3328, $11,770; 3312, $8,180; 3323, $43,500; 3328, $17,606; 3329, $14,500; 3331, $14,621; to Liberty Constr. Co., 917 Chamber of Com. Bldg., 3321, $15,683; to R. D. Baker, 1454 Penobscot Bldg., 3327, $5,850; 3330, $14,600; Western Constr. Co., 1208 Ford Bldg., 3332, $53,566; 3181, $20,371; Lennane & McIlvenna, 1205 Book Bldg., 3232, $11,750.

Minn. Eveleth—Lawrence & McCann, Eveleth, awarded contract for No. Side sewer system, at $56,159; also water line from Va. Road to Adams location, at $15,530.

Minn., Pine Island—J. G. Rae, Tracy, awarded contract for bldg. Dist. Sewer 1, involving 2,969 lin. ft. 8-15 in., pipe, 9-13 ft. deep; laterals, Dist. 1; 13,334 lin. ft. 8-10 in. pipe, 5-15 in. deep; Dist. Sewer 2, 1,909 lin. ft. 8-15 in. pipe, 7-15 ft. deep; Laterals Dist. 2, 3,441 lin. ft. 8-10 in. pipe, at $40,557.

Minn., Rush City—Woodrich Constr. Co., Minneapolis, awarded contr. for bldg. san. sewerage system involving 19,025 lin. ft. 8-15 in. pipe, etc., at $42,092.

Neb., Loup City—Katz Constr. Co., 409 Brandeis Theatre Bldg., Omaha, awarded contract for outlet sewer and 2 lateral sewers, at $71,190.

Neb., Tekamah—Hansen-Willadsen & Co. awarded contract for sewers, at $84,000.

N. J., Atlantic City—Sutton & Corson Co., Ocean City, awarded contract for constr. of storm water drainage system, at $117,037.

N. Y., St. George, S. I.—J. Johnson Sons, West New Brighton, awarded contract for bldg. san. sewers in Seaside Blvd., Sea Ave., to 3,000 ft. west of Sand Lane, at $133,258.

N. C., Wilson—R. G. Lassiter, Oxford, N. C., awarded contract for extension of sewer and water systems; improve streets, etc. Construct 42,000 lin. ft. san. and storm sewers; 110 manholes; 200 catch basins, at total of $531,000 for entire contract.

Pa., Reading—Jas. O'Rourke awarded contract for constr. of the extension of 24-in. house sewer trunk line—3rd St. to Oley and Nicholls, at $221,637.

Pa., Philadelphia—Contracts for constr. of branch sewers totaling $126,500 awarded by mayor: J. Jos. McHugh, contr. for branch sewer in Vankirk St.—Jackson to Walker—at $35,000, which was the largest awarded.

Va., Richmond—Cheatwood & Driscoll awarded contract to construct sewer on Brookland Pk. Blvd., at $15,000.

Wash., Edmonds—Dahlstrom & Bjork, Seattle, awarded contr. for constructing sewer in Edmonds, at $22,793.

Wn., Seattle—Dahlstrom & Bjork, Seattle, awarded contr. for sewer construction, concrete pipe, at $22,793.

Wis., Amery—Rohr & Pratt, Pipestone, Minn., awarded contract for storm and san. sewers, at $32,992.

WATER SUPPLY AND PURIFICATION

Cal., Huntington Pk.—Bent Bros., 825 Central Bldg., Los Angeles, awarded contract for constr. of 1,000,000-gal reinf. concrete reservoir; also constructing pump house for city Water Dept. Est. cost, $17,000. Contract is based upon fixed sum, contractor and city to share fifty-fifty either loss or saving from est. cost. F. E. Trask, Cons. Engr.

Cal., San Francisco—Frederick Wilson & A. C. Dennis (his partner), Spokane, Wash., awarded contract to drive a 10-mile tunnel through solid rock on San Francisco aqueduct for new Hetch Hetchy water system. Contractor Dennis has opened headquarters at Groveland, Tuolumne Co., Cal.

Cal., San Joaquin—C. H. Cardin, Manteca, awarded contract for constructing A line pump canal involving abt. 190,000 cu. yds. and lateral BO, abt. 660 cu. yds., at about 70,000; G. A. Graham, Dinuba, awarded contract to construct about 50 bridges across laterals, at $7,056. Directors of Dist. ordered repairing and reinforcing of 5 main laterals to be done under direction of Dist. Supt.

Cal., Whittier—Baker Iron Works, Los Angeles, awarded contr. for furnishing city 1,400 ft. 14-in., 1,500 ft. 12-in., 2,850 ft. 10-in. and 5,400 ft. 8-in. riveted steel pipe, at $14,829.

Man., Fort Garry—Green & Elasser, 447 College Ave., Winnipeg, awarded contract for water mains here, at $150,000, including sewers contr. for which awarded to Fowler & Young, Elec. Ry. Chambers, Winnipeg.

N. B., St. John—Lock Joint Pipe Co., Winnipeg, Man., awarded general contract for extension to water system, at $360,000.

Ont., Toronto—Following contracts for 6-in. water mains for York Twp., awarded: 7 streets to A. Cavotti, 257 Euclid Ave., at $13,662; 10 streets to Mitchell & Mohan, St. Catharines, Ont., at $16,236; 3 streets at $2,067, to Gordon Thompson, 11 Holland Park Ave.

N. S., Windsor—D. Sutherland, care City Clerk, Windsor, awarded contract for excavating, backfilling and laying 11,000 ft. 12-in. cast iron pipe, to about $17,050.

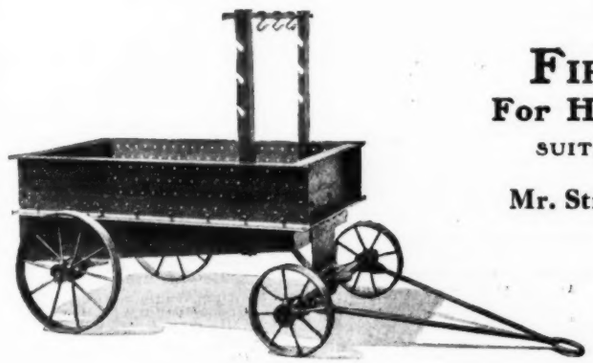
Sask., Yorkton—Walters, Neelin & Co., Yorkton, awarded contract (general) for constr. of reservoir, at $14,000; R. B. McLeod, Saskatoon, awarded contract for laying water mains.

Mass., Boston—Westinghouse Electric Mfg. Co. awarded contract for furnishing and erecting 2 pumping plants for high pressure fire service; one plant to be located at Lincoln power St. of Boston Elev. Ry. Co., Commercial St., and the other at 38th St. Station property of Edison Electric Illuminating Co., Atlantic Ave., at $174,469.

Mass., Boston—Jno. Williams & Co. awarded contract for laying and relaying water pipes in Sumner street, Kneeland St., Norway St., Public Alley No. 444, Poplar St., Kennard Ave., and Marshfield St., at $7,553.

Mich., Detroit—Raymond Concrete Pipe Co., New York, awarded contr. for approx. 438,000 lin. ft. concrete piles for fdn. of filter beds and coagulating basins, at $1,037,230.

Mich., Owosso—Ann Arbor Asphalt Constr. Co., Ann Arbor, awarded contract for furnishing labor and material for bldg.



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IN STRAIGHT OR MIXED CARS. Manufactured of OHIO RIVER FIRE CLAY.

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Pioneer Asphalt Co.
Sinclair Refining Co.
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The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

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Barber Asphalt Paving Co.
The Barrett Co.
Bitoslag Paving Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
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The Barrett Co.
Sinclair Refining Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The

Asphalt Plants.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Railroad Plants.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Barber Asphalt Paving Co.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.

Auto Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Co., The
Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies, Dump—Motor Truck.
Columbian Steel Tank Co.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

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Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Pawling and Harnischfeger.

Buckets, Grab.
Mead-Morrison Mfg. Co.

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Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

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Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement, Portland.
Portland Cement Association.

Cement Testing.
Kirschbaum, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Centrifugal Pumps.
De Laval Steam Turbine Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The.

Concrete, Reinforcement.
American Steel & Wire Company
Truscon Steel Co.

Concrete Sewer Pipe.
De Smet Quartz Tile Co.

Concrete, Tanks.
Mensch, L. J.

Concrete Tile.
De Smet Quartz Tile Co.

Conduits.
Cannelton Sewer Pipe Co.
Philip Carey Co., The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith
Flood, Walter H., & Co.
Samuel A. Greeley
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander
Shields, W. S.
Van Trump, Isaac.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The.

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The
Storms Mfg. Co.

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Culvert Pipe, Vitrified.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co., The

Dump Wagons.
Austin-Western Road Machinery Co., The

Dust Laying Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Elastite.
Philip Carey Co., The.

Electrical Wires & Cables.
American Steel & Wire Company

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The.

Expansion Joint Compound.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
Sinclair Refining Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Grab Buckets.
Mead-Morrison Mfg. Co.

Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

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The Jordan & Steele Mfg. Co., Inc.
Good Roads Machinery Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists—Motor Truck.
Columbian Steel Tank Co.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Iron Fence.
Cincinnati Iron Fence Co.

Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

water filtration plant; 1,800,000 gals. capacity, at about $75,000.

Mich., Springwells—Oakwood Constr. Co., 165 Fort Blvd., Detroit, awarded contract by Village for furnishing labor and material for laying 5,000 ft. 6-in. cast iron water pipes on Edwin, Eugene, Freud, and F. & P. M. Aves., to connect with Detroit water mains, at about $15,000.

Minn., Eveleth—Lawrence & McCann, Eveleth, awarded contract for water line from Virginia Rd. to Adams location, at $15,530.

Minn., Freeport—Pittsburgh-Des Moines Steel Co., 8th and Tuttle, Des Moines, awarded contract for 60,000-gal. steel water tank on present steel tower, at $11,-350.

Minn., Pipestone—Hunt & Sons, Pipestone, awarded contract for pumping station here, at $13,818.

N. J., Hightstown—Contracts for new water system awarded by Council as follows: Steel tower and tank, 150,000 gals. capacity, to Pittsburgh-Des Moines Steel Co., at $14,000; filter to N. Y. Continental Jewel Filtr. Co., $8,000; general works plant, to Jno. Proctor & Co., New York, at $14,-500.

N. M., Ft. Stanton—C. Irving, 1525 Larimer St., Denver, Colo., awarded contract by Treas. Dept., Washington, D. C., for boiler and system of piping at U. S. Sanatorium here, at $12,584.

N. C., Wilson—R. G. Lassiter & Co., Oxford, N. C., awarded contract to extend water and sewer systems; improve streets, etc.; lay 13,700 lin. ft. 6-in. Cl. B water mains, $531,000.

Ohio, Akron—Garrett Constr. Co., Kent, awarded contract for bldg. 10 large filter beds, each having 2,000,000-gal. daily capacity, at $313,624.

Ohio, Cleveland—Seltzer-Round Realty Co., 6512 Detroit Ave., awarded contr. for laying water mains in Runnymeade Ave., involving 4,500 ft. 8-in. cast iron pipe, to A. Marra, Illuminating Bldg., at about $25,-000.

Okla., Spiro—Municipal Excavator Co., Oklahoma City, awarded contr. for sewers and water works, at $56,700 and $8,300, respectively.

S. D., Watertown—Coalsaet Bros. & Drees, Marshall, Minn., awarded contract for constr. of water mains on 5th St., S. E., at $2,648; on 3rd St., S. E., at $3,544.

Tex., Galveston—J. W. Zempter, Galveston, awarded contract to construct reservoir; concrete, 1,750,000-gal. capacity, at $41,941.

Tex., San Benito—J. W. White, Bay City, Tex., awarded contract for pile driving, at $13,238.

Va., Bedford—R. L. Robertson & Co., Bedford, awarded contract for extensive impvts. to Bedford Water Wks., to include erection of a $20,000 brk. or concrete filter bldg.; Chicago Brdg. & Iron Co. will furnish steel tower and tank; Roberts Filter Co. will furnish filter equipt.

Wn., Seattle—H. J. Allen awarded contract for constr. of power house for Cedar Falls project, at $28,734.

Wis., Tomahawk—Chicago Brdg. & Iron Wks. awarded contract for 60,000-gal. water tank, at $8,600.

PROSPECTIVE WORK

ROADS AND STREETS

Ark., Little Rock—Jas. H. Rice, City Engr., and S. L. White, Atty., began circulation of petition for organization of an impvt. dist. for repaving or repairing Main St. Mayor in favor of impvt.

Ark., Russellville—Ellsworth & Coker, Hot Springs, Ark., preparing plans for work in Rd. Impvt. Dist. No. 2, Pope Co. Work will consist of 51 miles hard surfaced road from Russellville north to river and north to Dover. Dist. will issue about $600,000. This district will include about 10 or 12 blks. paving in Russellville; probably macadam with asph. top. Plans also call for several conc. brdgs., 40 to 60 ft., and several steel bridges, 60 to 100 ft.

Ark., Springdale—Impvt. Dist. formed at Fayetteville to pave public square. Est. cost, $24,000. Instead of voting bonds it was decided to pay cash, each property owner voluntarily agreeing to pay his proportionate amt. Three-fourths of required amt. on hand and no trouble is anticipated in securing remainder.

Ariz., Phoenix—First rd. to be paved in Maricopa Co. under the $4,000,000 bonds issue, for paving 278 miles of county roads, will be the Yuma Rd. Road will be paved for 10 miles west of City. Fed. Aid funds will be matched for the first 6½ miles.

Cal., Huntington Pk.—City about to begin proceedings for extensive street impvt. work. Program includes streets where water mains are to be laid but a number of streets will be graded and paved at once where new water system will not disturb operations.

Cal., Los Angeles—Council has adopted resolutions for grading and paving with 3½-in. bitum. base and 1½-in. Warrenite-Bitulithic wearing surf. Avenue 43—Homer St. to Pasadena Ave.; grading and paving with 5-in. conc. paving in Ave. 43—Homer Ave. to Griffin Ave. and constr. of cement curbs, walk, conc. gutter, 2 catch basins and 5 house connections, sewers; grading and oiling and constructing cement curb and walk, conc. gutter, rein. conc. culvt., catch basins, two end walls and pipe railing in Ave. 57—York Blvd. to Aldama St.; also scarifying and oiling 9th St.—130th west of Fifth Ave. to Crenshaw Blvd.; 40th Pl.—Raymond to Normandie Aves.

Cal., Los Angeles—Council has adopted Ords. for following street work: Scarifying and oiling alleys in blk. bounded by 7th St., Esperanza St., Atlantic St. and Spence St.; alleys so. of 52nd St. and west of Denker Ave.; 1st alley so. of Manitou Ave.—Thomas St. to Gates St.; 1st alley south of Fairmount St.—Ganahl St. to 1st alley east; and alley so. of Hub St. to Nolden St. to Avenue 56.

Cal., Los Angeles—Council has ordered to scarifying and oiling Barranca, 11th, Federal, Chase, Elder, 59th and 10th Sts., Crenshaw Blvd., Oxford Ave., and three alleys.

Cal., Pasadena—Los Angeles may join with Pasadena in the constr. of a scenic boulevard up bed of the Arroyo Seco from Garvanza to the mountains. Mr. Dewey, City Engr., Pasadena.

Cal., Riverside—Co. Engr. Fulmor making survey of proposed new road from desert side of Mt. San Jacinto up Palm canyon to Vandeventer flats on shoulder of the mountain.

Cal., Riverside—Co. Surv. instructed to prepare specfs. for paving 3 miles Corona-Elsinor Hwy. for which supvrs. have apportioned the $60,000 of the $175,000 of the

THE CUMMER ROAD ASPHALT PLANT

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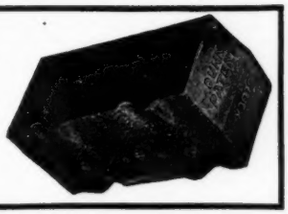

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1 Broadway, NEW YORK.

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Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Asn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L. The.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. C o.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Smith Co., T. L., The.

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
New Orleans Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Clay Products Association.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
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Wood Block (Creosoted).
Barrett Co., The
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Wood Preservatives.
Barrett Co., The
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$175,000 county road fund for coming year.

Cal., Riverside—Appropriation of $10,000 for road machinery has been provided by Supvrs. in Riverside Co. Rd. budget.

Cal., San Luis Obispo—County Engr. Warren B. Burch instructed by supervisors to prepare plans for resurfacing Paso Rovles-Creston Rd.

Cal., Santa Ana—Bids will be asked in near future for surfacing 15 miles of concrete hwy. system with 1½-in., and 2-in. asphalt wearing surface. J. L. McBride, Co. Engr.

Cal., Santa Barbara—New paving specfs. being prepared by City Engr. Morrison to include Topeka, sheet asph. and asph. concrete in addition to Warrenite for city streets.

Colo., Colorado Springs—$1,100,000 bonds voted here for grading projs. in city.

Colo., Denver—7 miles conc. hwy. betw. Denver and Arvada have been approved by local office U. S. Bureau Pub. Rds. Work on road will probably start this fall.

Ida., Boise—Several miles of walks and curb impvts. will be made on S. Boise St. this fall. Broadway St. will also be improved from bridge to Garfield Sch.

Ill., Peoria—City Council considering 3 paving projects: Penn. Ave. from Knoxville to Indiana Aves., $19,000; Missouri Ave. —Nebraska to Frye Ave., $6,000, and Starr St.—Western to Folkers Aves., $72,000.

Ind., Fort Wayne—Bd. Public Works will open and extend State Blvd. across right-of-way of New York Central and N. W. Electric Ry., and will connect with Lincoln Hwy. Will also constr. sidewalks on north side E. Butler St.—Clinton to Barr Sts., and repairs will be made on Calhoun St.

Ia., Des Moines—Bids will be called for in near future for paving Norise St.; brick and asph. concrete. K. C. Kastberg, City Bldg., Engr.

Ia., Fort Dodge—Ready for bids soon for road work. Proj. 25-B. approx. 10 miles; Rd. No. 23, 60,000 and 35,000 ft. tile. C. A. Snock, Aud. Webster Co.; L. Stephensen, Engr. Will take bids in late fall for graveling and repairing 8 miles of road. Plans under way.

Kans., McPherson—Petitions are being circulated which call for over two additional miles of pavement. N. Main St. petition calls for mile of impvt.; Gildersleeve St. on list; E. Elizabeth St., already approved, and N. Chestnut also being considered.

La., Shreveport—$100,000 bonds voted to pave road links from city to parish line; $60,000 bonds voted for resurfacing streets.

Me., Augusta—State Hwy. Comn. plans to construct highway from Skowhegan to Fairfield, macadam. Abt. $226,000. P. D. Sargent, Comnr.

Md., Leonardtown—St. Marys Co. Comnrs. will construct 2 miles hard surfaced road from Laurel Grove to State Rd. at Harper's Cor.; 20 ft. wide. $50,000 bonds sold.

Minn., St. Paul—Council will hold hearing Oct. 15 on paving as follows: (a) Berkeley Ave. betw. Snelling-Fredericka Sts.; (b) Wellesley Ave.—Snelling to Fredericka; (c) Stanford Ave.—Snelling-Fredericka Sts. City Purch. Agt. H. W. Austin.

Minn., St. Paul—City Planning Comm. of St. Paul Ass'n. unanimously approved recommendations for a $5,000,000 bond issue for constr. and maintenance of paving, park impvts., sewers, etc.

Mo., Kansas City—Property owners will forward statement to Bd. Pub. Wks., that new type of granite-topped vibrated concrete pavement be laid on Main St.—33rd to 39th Sts.

Mo., Milan—City plans to pave 10 streets; 14,000 sq. yds. vitr. brick on 3-in. conc. base. E. T. Archer & Co., Engrs. New England Bldg., Kansas City, Mo.

Mo., Oregon—Holt County having plans prepared for paving 66⅔ miles Mound City-Oregon Road, 18 ft. wide; concrete. Leslie-Barnes, Engr. Co., Am. Nat'l. Bk. Bldg., St. Joseph, Engrs.

Mo., Paris—Monroe County Court has authorized 32 new culverts (concrete).

Mo., Savannah—Andrew County having plans prepared for grading and bldg. brdgs. on 26 miles N. and S. Road, 18 ft. wide. Leslie-Barnes Engr. Co., Am. Nat'l. Bank Bldg., St. Joseph, Engrs.

Mo., Unionville—City considering paving of 15 streets; 24,000 sq. yds. vitr. brk. on 3-in. concrete base; E. T. Archer & Co., Engrs., New England Bldg., Kansas City, Mo.

Neb., Wisner—Making plans for about 30 blocks of paving. Will ask bids. Engineer favors brick. Would consider sheet asph.

N. J., Mays Landing—Bd. of Freeholders, Atlantic Co., plans to rebuild 9 mi. of blvd. betw. Absecon and Chestnut Neck. A. H. Nelson, Guarantee Trust Bldg., Atlantic City, Engr.

N. J., Morristown—Bd. of Freeholders, Morris County, contemplates improving 14 miles **Morris Turnpike. Abt. $700,000. H.** W. Vetter, Belvidere, Engr.

N. J., N. Bergen (Weehawken, P. O.)—City having plans and specfs. prepared for paving 31st St., bitum. Cost will exceed $75,000. P. E. Daly, 32nd St., Engr.

N. M., Roswell—Sec'y. of Agriculture, Washington, D. C., has approved expendt. of $30,000 Fed. Rd.; funds for graveling Ruididoso Rd., beginning at north side of Wescalero Indian Reservation.

N. Y., Syracuse—Bd. of Supvrs. made following appropriations from Motor Vehicle fund for impvt. of town roads: $2,000 to Van Buren for impvt. of E. Deadwood Rd.; $1,500 for Spafford for general road impvts.; $1,000 to Pompey and $2,500 to Lysander for impvt. of rds.

N. C., Nashville—Bd. of Alderman plan to pave 1¼ miles various streets. Mees & Mees, 310 Trust Bldg., Charlotte, Cons. Engrs.; Anderson: Comnrs. Anderson Co. contemplates bldg. 20 mi. Anderson-Abbeville Rd.; also 25 miles Anderson-Greenville Rd. C. H. Morefield, Columbia, Engr.; Camden: Comnrs. Kershaw Co. plan to construct 30 miles Camden-Ridgeway Rd. C. H. Morefield, Columbia, Engr.; Spartanburg: Comnrs. Spartanburg Co. plan to build 18 mile rd. from here to North Carolina line. C. H. Morefield, Engr.; York: Comnrs. York Co. plan to construct 15 mile rd. from here to Cherokee line. C. H. Morefield, Engr.

Okla., Sapulpa—Five new city parks have been laid out by Park Bd., to be connected by special traffic boulevard. This includes entire parking system of city. All plans before becoming final were submitted to civic committees and citizens, and were approved.

Okla., Sulphur—City contemplates constructing (paving) streets; 8,000 sq. yds. brick and 56,000 sq. yds. rock asph. paving on 4-in. concrete base. E. T. Archer & Co., Engrs., New England Bldg., Kansas City, Mo.

Okla., Oklahoma City—State Hwy. Department contemplates paving 1 mile road connecting with Walter's paved city road.

Ore., Oregon City—Included in paving program of State Hwy. Comm. is stretch of road betw. Canby and Aurora, abt. 5 miles.

S. D., Rapid City—Citizens favor bldg. road from Keystone to Triangle D road (St. Hwy.), 8 miles of new road. A. D. Clift, Aud. Pennington Co.

Tenn., Benton—Polk Co. Court voted $100,000 for each of the two proposed highways; one from Prendergast to Tennga as part of proposed Jackson Hwy. from Knoxville to Atlanta, the other from this Hwy. southeast to Hunter's Switch, no. of Ducktown.

Tex., San Antonio—City will surface and pave 5 miles Rock Quarry road and Kendall St.; 16 ft. wide; asph. Will invite bids. H. Helland, City Engr.

Tex., Dallas—City, at request of property owners, will pave Beckley Ave.—10th St. to Zang's Blvd.

Tex., Del Rio—State Hwy. Comm. has granted $125,000 for road construction in Val Verde Co., which is to be expended in connection with a $400,000 bond issue.

Va., Newport News—City Engr. instructed to prepare plans for paving Warwick Ave., and a strip on 12th St.; also submit est. on what it will cost to grade 12th St.

Va., Richmond—Engrs. drawing plans for widening of Bank St. One plan calls for widening 20 ft., while another plan will only make it 15 ft. wider than it is now. Work will begin as soon as plans are completed.

Wis., Hartford—City plans to grade and macadamize 11.5 blks. McKinley St., 18-20 ft. wide. W. Radke, Clk.

SEWERAGE AND SEWAGE TREATMENT

Ark., Dermott—Comnrs. City Sewer Dist. plan to advertise for bids shortly for sewer extension. Est. cost, $75,000. E. E. Barlow, Comnr. Ford & McRae, Little Rock, Engrs.

Ark., Russellville—Sewer Dist. No. 2 will issue abt. $10,000 bonds. Ready for bids in about two months.

Cal., Burbank—Koebig & Koebig, Title Ins. Bldg., Los Angeles, Cons. Engrs., will submit at next meeting of City Trustees, estimates of cost of sewer system for city.

Cal., Holtville—$11,500 bond issue for impvts. to sewer system carried at special election.

Ont., East Sandwich—Township plans to construct 6 mile trunk sewer; one from Ford City to Peach Island and the other from Sandwich to Peach Island. About $200,000.

Ill., Cairo—City will open bids in October for bldg. 6-36 in. sewers in 38th St. Abt. $80,000. G. F. Dewey, 613 Ohio St., City Engr.

Ill., Rockford—Nearly $100,000 to be spent for new sewer systems in various sections of city, provided for in Ords. presented at Council meeting. It is understood that additional Ords. for sewer connects. will also be presented which will bring the figure beyond $100,000.

Kans., Wichita—P. L. Brockway, City Engr., in compliance with request of City Comnrs., presented list of streets to be paved. Also recommended that storm sewer be constructed on West Side near First St. on account of large amount of water left standing on First St. after rains. Est. cost, $45,000 to $50,000. It is imperative city construct sewer at once.

Ky., Lexington—City Comnr. Public Wks. McCorkle, considering enlarging storm-water sewer system. Election soon to vote on $300,000 bonds.

La., New Orleans—Sewerage and Water Bd. considering constr. and enlargement of water, sewer and drainage facilities. $7,600,000 available for next 4-yr. period.

Mich., Detroit—City plans to construct 2,593 ft. sewer in Halleck Ave., from Jos. Campeau to Dequindre Sts., 4-5 ft. cylinder, etc.; also 3,898 ft. in Bauman and State Fair Aves.—Seven Mile Rd to Ralston Ave., 5 ft. 3 in., 7 ft. 6 in. cylinder, both brk. conc., and segmental blk. C. W. Hubbell, City Engr.

Mich., Muskegon—Residents Moffett St., in the Heights, betw. Hovey and Hackley Aves., have petitioned Council for sanction to sewer on above street, residents agreeing to pay for it on conditions by which Peck St. sewer is being installed. Proposition to be turned over to City Engr., to prepare ests. on costs, etc.

Mich., Sault Ste Marie—Engineers Hoad and Decker, England Bldg., Ann Arbor, are preparing plans for sewerage system in South Side Dist. $25,000.

Mo., Plattsburg—City contemplates constructing sewer extensions; $50,000. E. T. Archer & Co., Engrs., Kansas City, Mo.

N. J., Haledon—Boro having plans prepared for sewerage system. H. J. Harnder, 692 14th Ave., Paterson, Engr.

N. J., Phillipsburg—New sewerage system and disposal plant will cost $282,106, according to revised figures just submitted.

N. Y., Brooklyn—An effort to save to the Hollis section of Queens, a large and important mfg. concern, is now being made by Boro Pres. Connolly and Engrs. of Queens Sewer Bureau. Draing. maps for section of Hollis, contingent to Fulton St. betw. Harvard and Weber Aves. have been placed before Bd. of Est. for adoption.

N. C., Burgaw—Town plans constr. of sewer and water systems. Carolina Engr. Co., Engr., 412 Southern Bldg., Wilmington, N. C.

Ohio, Marion—Council may call special election in November to vote on proposed sewage system and garbage disposal plant. Bond issue is in accord. with plans drawn by Geo. B. Gascolgne, Cleveland, San. Engr. Impvt. will cost abt. $500,000. Sewers will provide for population of 100,000 and disp. plant for city of 50,000.

Okla., Oklahoma City—Pearse, Greeley & Hansen, Chicago Engrs., retained to prepare plans for sewage disposal.

Pa., Wilkes Barre—Plans for new modern sewer for Newport Twp., completed by Young & Wintermute, Engrs., Wilkes Barre. Est. of the cost of installing same will soon be made.

S. D., Watertown—Petitions filed for sewer on 8th St., betw. 3rd and 8th Sts., E. and on 8th St. to 9th Ave., S. E. B. Mather, City Aud.

Tex., Dallas—Huge storm sewer will be laid in Pacific Ave., to carry off all surface water from that section of city lying north. Sewer will graduate in size from 6½ ft. at the river to 5 ft. where it will connect with present sewer at Pearl St. Est. cost, $200,000. Geo. Fairtrace, City Engr. Laterals will be put on intersecting Sts. north of Pacific Ave., principal ones being on Bryan, Akard, Griffith and Lamar.

Wn., Spokane—Oct. 18th set by Council as date of hearing on new proposed downtown trunk sewer. City Engr. Butler estimates cost of proj. at approx. $300,000.

Wis., Burlington—Prelim. plans being prepared for new sewerage system. C. H. Tubbs, local Engr. Abt. $75,000.

Wis., Milwaukee—Sewerage Comn. having plans prepared and contemplates con-

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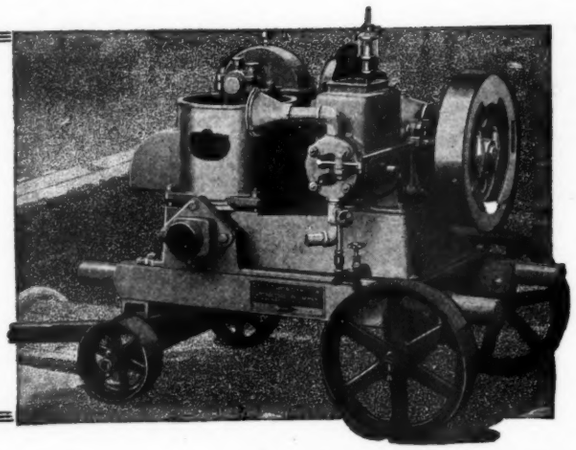

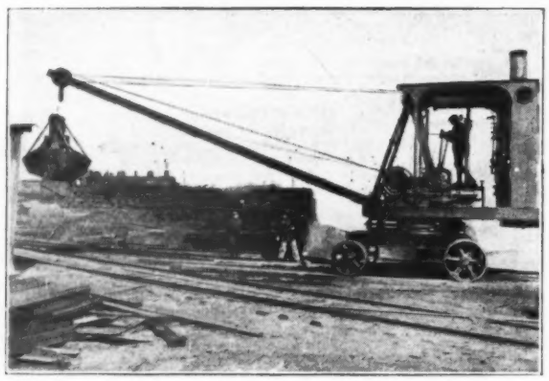

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str. of following work during 1921: sewage tanks and equipt. to cost abt. $2,175,000; power house and equipt., $250,000; boilers, piping and equipt., $500,000; fine screen bldg. and equipt., $325,000; inner dock, $200,000; sludge dryers, press and equipt., $274,000. T. C. Hatton, Chief Engr.

WATER SUPPLY AND PURIFICATION

Ark., Ft. Smith—New boilers are needed at water plant and more filter beds must be added. Comnr. M. F. Smith.

Cal., Angels Camp—This town and three neighboring towns are to have meters installed.

Cal., Riverside—Bd. of Pub. Utilities has authorized purchase of 2,160 ft. 14-in. pipe for 10th St. water main connecting with Rubidoux reservoir; 1,250 ft. 14-in. pipe for Locust St. and 2,021 ft. 6-in. pipe for 5th St.

Cal., San Diego—Specfs. for chlorination plant to be installed in connection with city water supply from Lake Hodges, approved by Council. Plant will have a capacity to treat not less than 3,000,000 gals. per day. F. A. Rhodes, City Mgr., prepared the specfs.

Ont., Fenelon Falls—Village plans to construct water works and fire protection plant, including pump house, electric pumps, cast iron distribution system and reservoir or elev. tank. Abt. $50,000. O. Smith, Lindsay, Engr.

Cal., Vallejo—City having estimates made for bringing water here and to Mare Island Navy Yard from Gordon Valley. City Comn. plans election to vote on bonds in excess of $1,000,000 for project. T. D. Kilkenny, City Engr.

Ont., Chatham—Dr. McRitchie, M. O. H., recommends erection of new tank for water chlorination.

Ont., Fenelon Falls—Plans being prepared for new water system, including pump house and installation of electrically operated centrif. pumps. Oliver Smith, Lindsay, Engr.

B. C., Ioco—The Ioco Townsite, Ltd., has made application to the provincial government for water right of 50,000 gals. per minute to be taken from unnamed creek near Port Moody, for water works and fire purposes.

Ont., Hawkesbury—$65,000 appropriated for water and sewer systems. V. E. Belanger, Supvr.

Conn., Bridgeport—Complete metering of city is planned by Bridgeport Hydr. Co.

Ill., Waukegan—Council has passed resolution and estimate of cost on following: 10,227 ft. 6-in. and 1,350 ft. 10-in. cast iron water pipe; 17,421 ft. 6-in. to 24-in. vitr. tile pipe sewer and 57 mnaholes. Water proj. includes 19 fire hydrants and 25 gate valves. Est., $63,234. Sewer est., $73,970. M. J. Douthitt, City Engr.

Ia., Anamosa—Engineer will be appointed to make survey of impvts. to water system. W. F. Hathaway, Vil. Clk.

Kans., Topeka—City has retained Black & Veatch, Engrs., Interstate Bldg., Kansas City, Mo., to prepare plans for water purification plant. About $400,000.

Me., Lincoln—Lincoln Water Co. has been directed by State Public Utilities Comn. to install approx. 2,700 ft. of mains from 2 to 6 in. sizes, if town will authorize 2 hydrants to be paid for at regular rates.

Mass., Brockton—City plans to build filter bed. About $150,000.

Mich., Bay City—Prelim. plans being prepared for constr. of new filtration plant and reservoir and improved pumping system. Approx. cost, $2,000,000. Frazier-Elms-Shael Co., 1223 Illuminating Bldg., Cleveland, Ohio, Engrs.

Mich., Charlotte—Plans being prepared by R. A. Murdock, Engr., 628 Free Press Bldg., Detroit, for extension and addns. to water works system. Abt. $50,000.

Mich., Detroit—City contemplates bldg. extensions to water wks. system in Marjorie Ave.—Center Line to Van Dyke Aves.; Wayburn Ave. north of Warren Ave.; Guthrie Ave. west of Center Line Ave. and Warren Ave., from Alter Rd. to Wayburn Ave., to include laying 6-16 in. c. i. pipe, furnishing valves, gate boxes, etc. About $50,000. Pipe will be purchased and laid by Day Labor under supervision of Water Bd. Supt., T. A. Leisen, Water Works Park Engr.

Mich., Ferndale—Village having plans prepared by G. Jerome, Engr., 1331 Majestic Bldg., Detroit, for bldg. 6 and 8-in. cast iron extensions to water works system, including valves, valve boxes, etc. About $65,000.

Mich., Grand Rapids—Plans being prepared for bldg. extensions to water works system, to include pump house, 2 pumps with 8,000,000-gal. daily capacity, addns. to filtr. plant, 3,000,000-gal clear water well and head house. C. A. Paige, City Engr.

Minn., Owatonna—Council contemplates installing air-lift and other equipt. at municipal water plant. C. J. Sevatins, Vil. Clk.

Mo., Moberly—City will erect pumping station; filtr. plant; dam and reservoir. Fuller & Beard, Engrs., Chem. Bldg., St. Louis, Mo. Lately voted $175,000 bonds.

N. Y., Kenwood—Citizens of Kenwood and Sherrill have authorized Bd. of Commissioners of comb. water dist. to issue $175,000 bonds to install water system to serve both communities.

Ohio, Newark—City ordered by State Bd. of Health to construct filtr. plant.

Ore., Ashland—$100,000 bonds voted here to construct reservoir in Ashland canyon, which will hold 100,000,000 gals. of water to augment present supply.

Ore., La Grange—Council will investigate suggestion made by W. M. Coughenour, Payette, Idaho, to bring water from Anthony Lake, near N. Powder, abt. 8 mi. from head of Besver Lake, where city is now getting water.

Ore., Salem—Because city water supply at Estacada, Clackamas Co., is not safe, State Bd. of Health has ordered mayor to install chlorinator plant, or some other approved method of purification. Action must be taken within 30 days.

Wn., Walla Walla—Work will probably commence this fall on impvt. of water system here. Meeting of Water Board will be called as soon as possible and bids for job advertised.

Wis., New Holstein—City has plans prepared and will receive bids in spring for bldg. water works system to include 80,000-gal. steel tank, artesian well, 6-10 in. cast iron pipe, etc. $40,000 bonds voted for project. J. Donohue, N. 8th St., Sheboygan, Engr. L. Heppe, Clerk.

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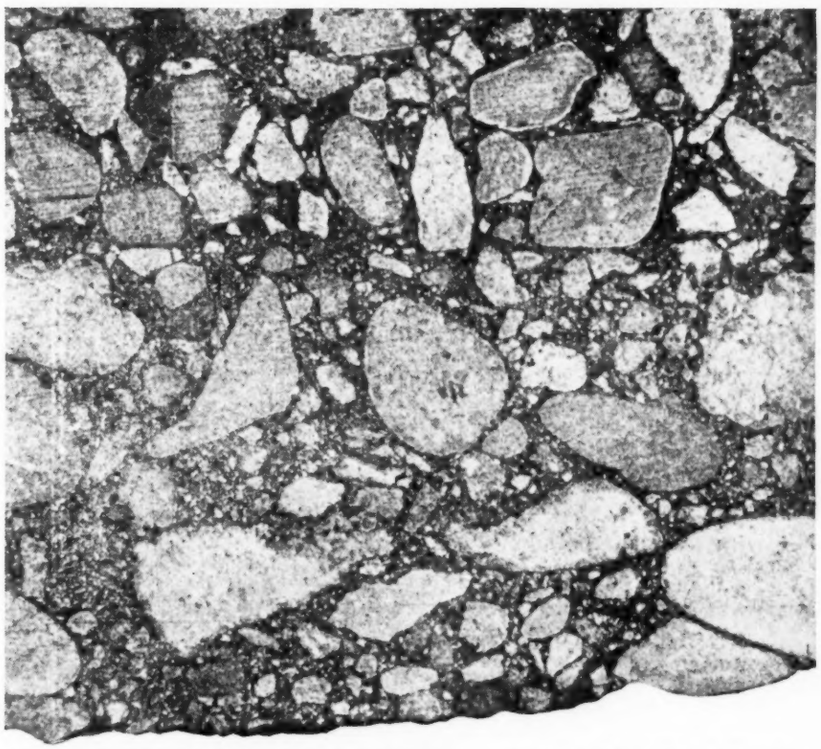

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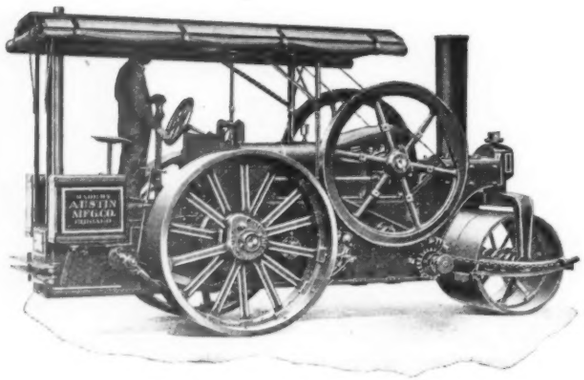

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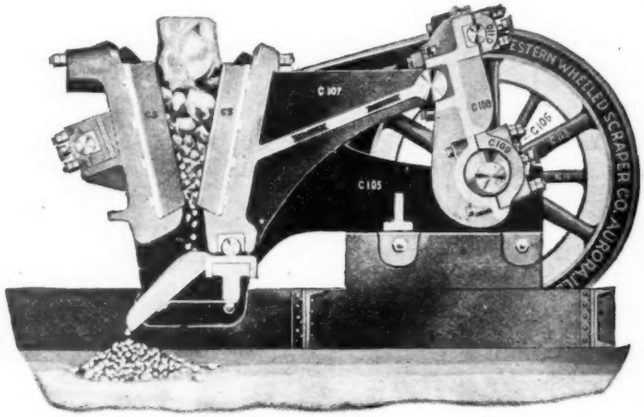

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